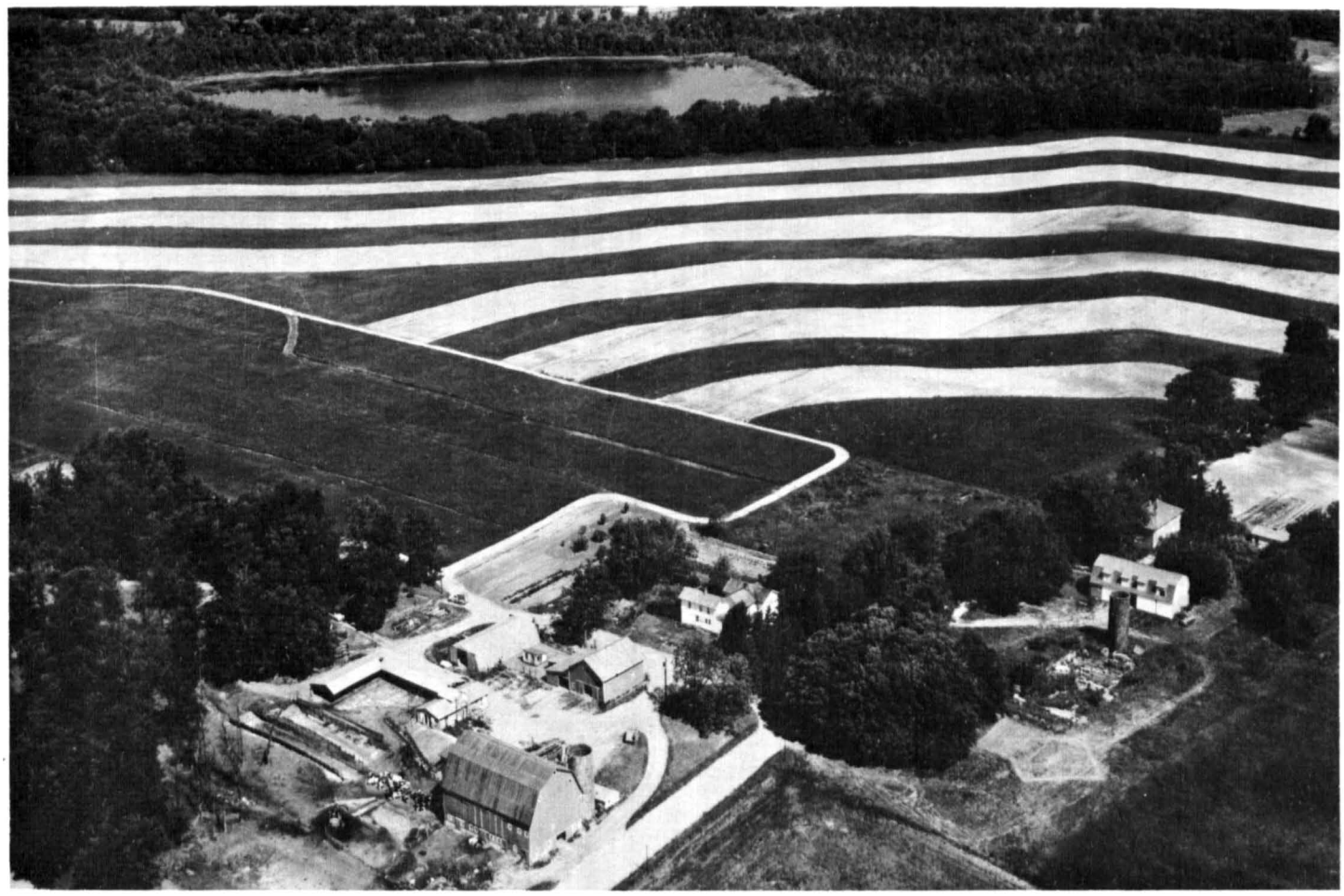
SOIL SURVEY OF

Clinton County, Michigan



United States Department of Agriculture
Soil Conservation Service
in cooperation with
Michigan Agricultural Experiment Station

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all who need the information, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1964–73. Soil names and descriptions were approved in 1973. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1973. This survey was made cooperatively by the Soil Conservation Service and the Michigan Agricultural Experiment Station. It is part of the technical assistance furnished to the Clinton County Soil Conservation District.

Preparation of this soil survey was partly financed by the Clinton County Board of Commissioners under provisions of an agreement with the Soil Conservation Service, United States Department of Agriculture, and partly by an urban planning grant from the Department of Housing and Urban Development under provisions of section 701 of the Housing Act of 1954, as amended.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Clinton County are shown on the detailed map at the back of this survey. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by a symbol. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Index to Mapping Units" on page ii lists all the soils in the county by map symbol and shows the page where each soil is described. The capability unit, woodland suitability group, and woody plant group to which each soil has been assigned are specified at the end of the soil description.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units.

Foresters and others can refer to the section "Woodland," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

Community planners and others can read about soil properties that affect the choice of sites for nonindustrial buildings and for recreation areas in the sections "Recreation" and "Town and Country Planning."

Engineers and builders can find, under "Engineering," tables that contain estimates of soil properties and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of Soils."

Newcomers to the county may be especially interested in the section "General Soil Map," where broad patterns of soils are described.

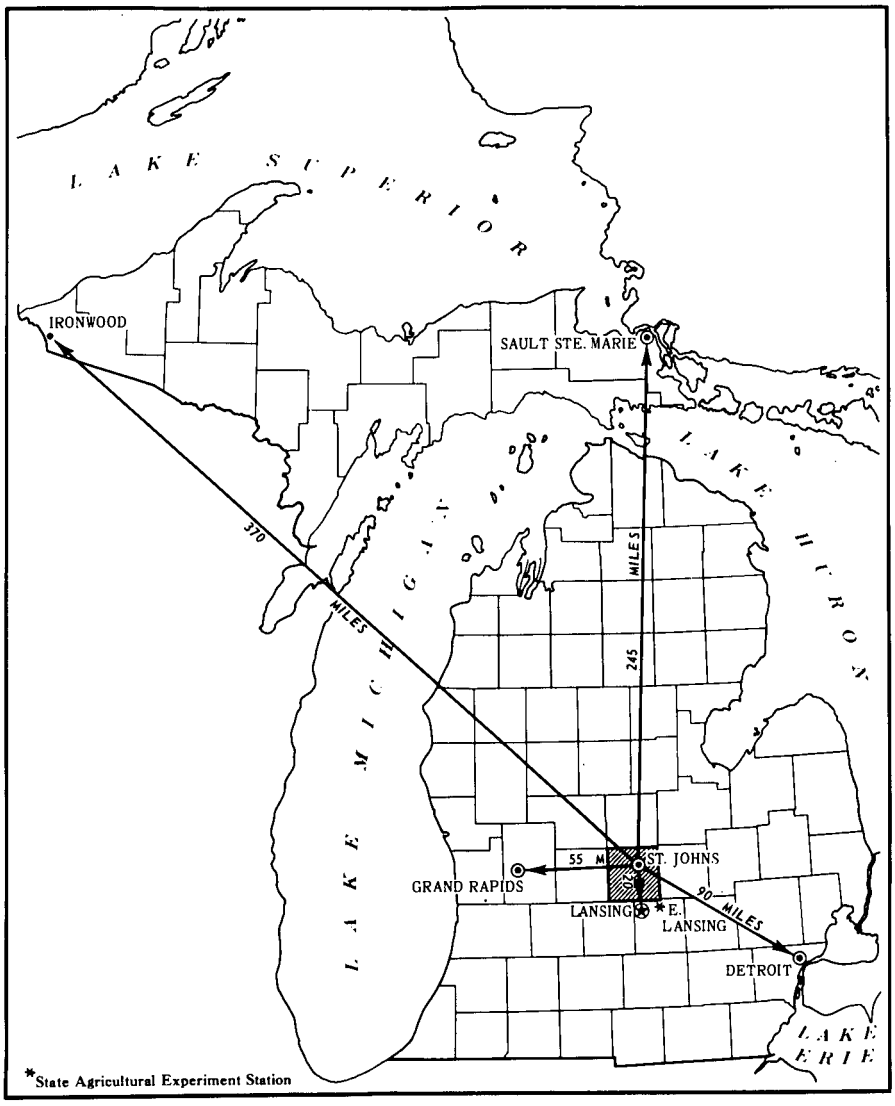
Cover picture: Sloping areas of Marlette soils, protected by contour strips, near a wooded area of Houghton muck in soil association 4.

Contents

Issued February 1978

Index to Mapping Units

Summary of Tables



Location of Clinton County in Michigan.

SOIL SURVEY OF CLINTON COUNTY, MICHIGAN

BY KARL E. PREGITZER, SOIL CONSERVATION SERVICE

FIELDWORK BY PAUL CORDER, ALVIN IRVINE, DAVID LIETZKE, JOHN LONG, KARL PREGITZER, AND GLENN WEESIES, SOIL CONSERVATION SERVICE, AND WALEED ALAGIDE, DAN AMOS, AND DAVID DROSHA, MICHIGAN AGRICULTURAL EXPERIMENT STATION

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE MICHIGAN AGRICULTURAL EXPERIMENT STATION

CLINTON COUNTY is in the south-central part of the State (see facing page). St. Johns, the county seat, is approximately 20 miles north of Lansing, the State capital. It is within 50 miles of Flint, Mount Pleasant, and Saginaw. The county has an area of 571 square miles, or 365,440 acres.

In 1970, the population was 48,555, according to U. S. Census (*8*).[1] Farming is the main industry, and most of the land is in farms. The climate is favorable for cash-grain, dairy, and livestock farming. Major crops are corn, field beans, wheat, soybeans, sugar beets, and alfalfa. Special crops, such as mint, vegetables, and lawn sod, are important crops grown on the extensive organic soils of Clinton County. Scattered small industries are throughout the county. Many residents are employed in nearby Lansing. The southeastern part of the county is an area of increasing urbanization and recreational use.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Clinton County, where they are located, and how they can be used. The soil scientists went into the county knowing they would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and nature of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures (*5*). The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Matherton and Owosso, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Marlette loam, 2 to 6 percent slopes, is one of several phases within the Marlette series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this survey was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. One such kind of mapping unit is the soil complex.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Owosso-Marlette sandy loams, 2 to 6 percent slopes, is an example. In those areas where the soil complex consists of two

[1] Italic numbers in parentheses refer to References, p. 86.

different phases within the same series, only the series is mentioned in the name of the complex. Boyer complex, 0 to 6 percent slopes, is an example.

In some areas there are places where the soil material is so variable or so altered by man that it has not been classified by soil series. These places are shown on the soil map and are described in the survey. Borrow land is an example.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when they are used for growing native and cultivated plants and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this failure to slow permeability or a high water table. They see that streets, road pavements, and foundations for houses crack on a given kind of soil, and they relate this failure to a high shrink-swell potential. Thus, they use observation and knowledge of soil properties, together with available research data, to predict the limitations or suitability of a soil for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their study and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in the survey area. A soil association is a landscape that has a distinctive proportional pattern of soils. It typically consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association can occur in another, but in a different pattern.

A map showing soil associations is useful to people who want to have a general idea of the soils in a survey area, who want to compare different parts of that area, or who want to locate large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide for broad planning on a watershed, a wooded tract, or a wildlife area or for broad planning of recreational facilities, community developments, and such engineering works as transportation corridors. It is not a suitable map for detailed planning for management of a farm or a field or for selecting the exact location of a road or building or other structure, because the soils within an association ordinarily vary in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The eight soil associations in this survey are described on the pages that follow.

1. Marlette-Capac-Parkhill association

Well drained to very poorly drained, nearly level to steep sandy loams to clay loams on moraines and till plains

This soil association is on broad, rolling to hilly uplands intermixed with shallow basins, swales, and depressed areas between slopes. The broad, well drained upland swells are dominated by gentle, convex slopes (fig. 1). Short, steeper slopes occur as rounded knobs and as ridges and the sloping sides of upland depressions, valleys, and drainageways.

This association makes up about 22 percent of the county. It is about 40 percent Marlette soils, 20 percent Capac soils, 10 percent Parkhill soils, and 30 percent minor soils.

The moderately well drained and well drained Marlette soils are on the gently sloping upland swells and the steeper knobs, ridges, and side slopes. The surface layer is very dark grayish brown loam 5 inches thick. The subsurface layer is 9 inches of pale brown loam. The upper 6 inches of the subsoil is yellowish brown, firm light clay loam and pale brown, friable loam. The next 8 inches is brown, firm clay loam. The lower 10 inches is brown, very firm clay loam. At a depth of 38 inches is pale brown, calcareous light clay loam.

The somewhat poorly drained Capac soils are on the nearly level and gently sloping lower concave slopes and broad till plains. The surface layer is dark brown loam 9 inches thick. The subsoil is 22 inches thick. The upper 3 inches is a mixture of yellowish brown, friable, mottled clay loam and pale brown loam. The lower 19 inches is yellowish brown, friable, mottled light clay loam. At a depth of 31 inches is calcareous, yellowish brown loam that has mottles.

The very poorly drained and poorly drained, nearly level Parkhill soils are in the dish-shaped depressions. The surface layer is very dark gray loam 9 inches thick. The upper 13 inches of the subsoil is dark grayish brown, friable, mottled heavy loam. The next 8 inches is mottled, grayish brown, firm clay loam. The lower 5 inches is mottled, gray, friable heavy loam. At a depth of 35 inches is calcareous, gray loam till.

Minor in this association are Boyer, Owosso, Houghton, Palms, Metamora, Corunna, Colwood, and Washtenaw soils. Boyer and Owosso soils are closely associated with Marlette soils. Houghton, Palms, and Washtenaw soils are in wet depressions. Metamora, Corunna, and Colwood soils are in very poorly drained to somewhat poorly drained, nearly level and gently sloping areas.

The soils of this association are generally well suited to farming. General farming, including some dairying and cash cropping, is the major use. The soils are naturally productive and, if well managed, are suited to crops commonly grown in the area. Drainage is needed on Capac and Parkhill soils and the associated wet soils. Erosion on upland slopes and maintenance of tilth are additional problems.

Figure 1.—Marlette soils on well drained upland swells in soil association 1.

The uses of the soils for recreation and wildlife are rapidly expanding in this association. The diversity of soils and the Looking Glass River, Sleepy Hollow State Park, and the numerous woodlots that occur within the association contribute to the growth of these land uses (fig. 2).

The rolling and scenic nature of the landscape has caused a shift in land use next to the expanding urban areas of Lansing. Here, general farms are intermixed with rural homes and small hobby farms. Rapid urban development is occurring on soils that have slight or moderate limitations for onsite sewage disposal. Elsewhere in this area the building follows city and township utility systems.

2. *Capac-Parkhill-Marlette association*

Very poorly drained to well drained, nearly level and gently sloping loams on till plains

This soil association is on flat to broadly undulating plains. The landscape is subdued (fig. 3) and has a few low ridges in places.

This association makes up about 45 percent of the survey area. It is about 48 percent Capac soils, 14 percent Parkhill soils, 10 percent Marlette soils, and 28 percent minor soils.

The somewhat poorly drained Capac soils occupy the broad, nearly level tops of low swells and short, gentle side slopes of wet depressions and broad flats. The surface layer is dark brown loam 9 inches thick. The upper 3 inches of the subsoil is yellowish brown, friable, mottled clay loam and pale brown loam. The next 8 inches is yellowish brown, friable, mottled light clay loam. The lower 11 inches is yellowish brown, friable, mottled light clay loam. At a depth of 31 inches is calcareous, yellowish brown loam that has mottles.

The very poorly drained and poorly drained, nearly level Parkhill soils are in shallow depressions and on broad flats. The surface layer is very dark gray loam 9 inches thick. The upper 13 inches of the subsoil is dark grayish brown, friable, mottled heavy loam. The next 8 inches is mottled, grayish brown, firm clay loam. The lower 5 inches is mottled, gray, friable heavy loam. At a depth of 35 inches is calcareous, gray loam till.

The moderately well drained and well drained Marlette soils are on the gently sloping low ridges and short side slopes along drainageways. The surface layer is very dark grayish brown loam 5 inches thick. The subsurface layer is 9 inches of pale brown loam. The upper 6 inches of the subsoil is yellowish brown, firm, light clay loam and pale brown, friable loam. The next 8 inches is brown, firm clay loam. The lower 10 inches is brown, very firm clay loam. At a depth of 38 inches is pale brown light clay loam.

Minor in this association are Metamora, Selfridge, Kibbie, Colwood, Houghton, Spinks, Boyer, Wasepi, Gilford, and Cohoctah soils. Metamora soils are closely intermingled with Capac soils. Selfridge soils are nearly level and gently sloping. Kibbie and Colwood soils are nearly level. Houghton soils are in wet depressions, and Spinks and Boyer soils are on low, narrow ridges. Wasepi, Gilford, and Cohoctah soils are in areas next to major drainageways.

The soils in this association are generally well suited to farming, and most of the acreage is farmed. These soils are naturally productive, and if well managed, they are suited to the crops commonly grown in the area. Cash cropping is increasing within the association. Drainage of Capac, Parkhill, and associated wet soils is necessary for the best yields. Maintenance of tilth is a problem on all of the soils. The few small woodlots are mostly in undrained areas. Most are pastured.

3. *Blount-Sims-Morley association*

Very poorly drained to well drained, nearly level to sloping loams and silty clay loams on till plains and moraines

This association is characterized by a series of low, irregular ground swells intermixed with slightly concave depressions and broad, irregular flats. Differences in elevation between the highest ground swell and the lowest basin do not exceed 60 feet. The differences are less than 10 or 15 feet in most places.

This association makes up about 9 percent of the survey area. It is about 40 percent Blount soils, 35 percent Sims soils, 9 percent Morley soils, and 16 percent minor soils.

The somewhat poorly drained Blount soils are in broad, nearly level areas and on low, gently sloping ground swells. The surface layer is dark grayish brown loam 9 inches thick. The upper 7 inches of the subsoil is grayish brown, firm, mottled clay loam. The next 10 inches is yellowish brown, very firm, mottled silty clay. The lower 5 inches is yellowish brown, firm, mottled silty clay loam. At a depth of 31 inches is calcareous, gray silty clay loam.

The very poorly drained and poorly drained Sims soils are on broad flats and in depressions. The surface layer is very dark gray light silty clay loam 9 inches thick. The subsurface layer is 5 inches of gray light silty clay loam. The upper 10 inches of the subsoil is gray clay loam. The next 12 inches is gray light clay loam. The lower 4 inches is gray silty clay loam. At a depth of 40 inches is gray silty clay loam.

The moderately well drained and well drained Morley soils are on ridges and short side slopes along drainageways. The surface layer is very dark grayish brown loam 5 inches thick. The subsurface layer is 6 inches of pale brown loam. The upper 7 inches of the subsoil is yellowish brown, friable loam. The next 8 inches is dark yellowish brown, firm silty clay loam. The next 14 inches is dark brown, very firm, mottled heavy silty clay loam. The lower 4 inches is yellowish brown, firm, mottled silty clay loam. At a depth of 44 inches is calcareous, brown, mottled silty clay loam.

Minor in this association are Marlette, Colwood, Kibbie, Houghton, Palms, Metamora, Corunna, and Selfridge soils. Marlette soils are on the same landscape position as Morley soils. Colwood and Kibbie soils are in shallow, wet basins. Houghton and Palms soils are in depressions. Metamora, Corunna, and Selfridge soils are in nearly level and gently sloping areas near streams.

The soils in this association are well suited to farming. The major enterprise is general farming, including dairy cattle, beef, swine, and cash crops. Mint is grown on the organic soils in places. Drainage of Blount and Sims soils is necessary for maximum yields. Mainte-

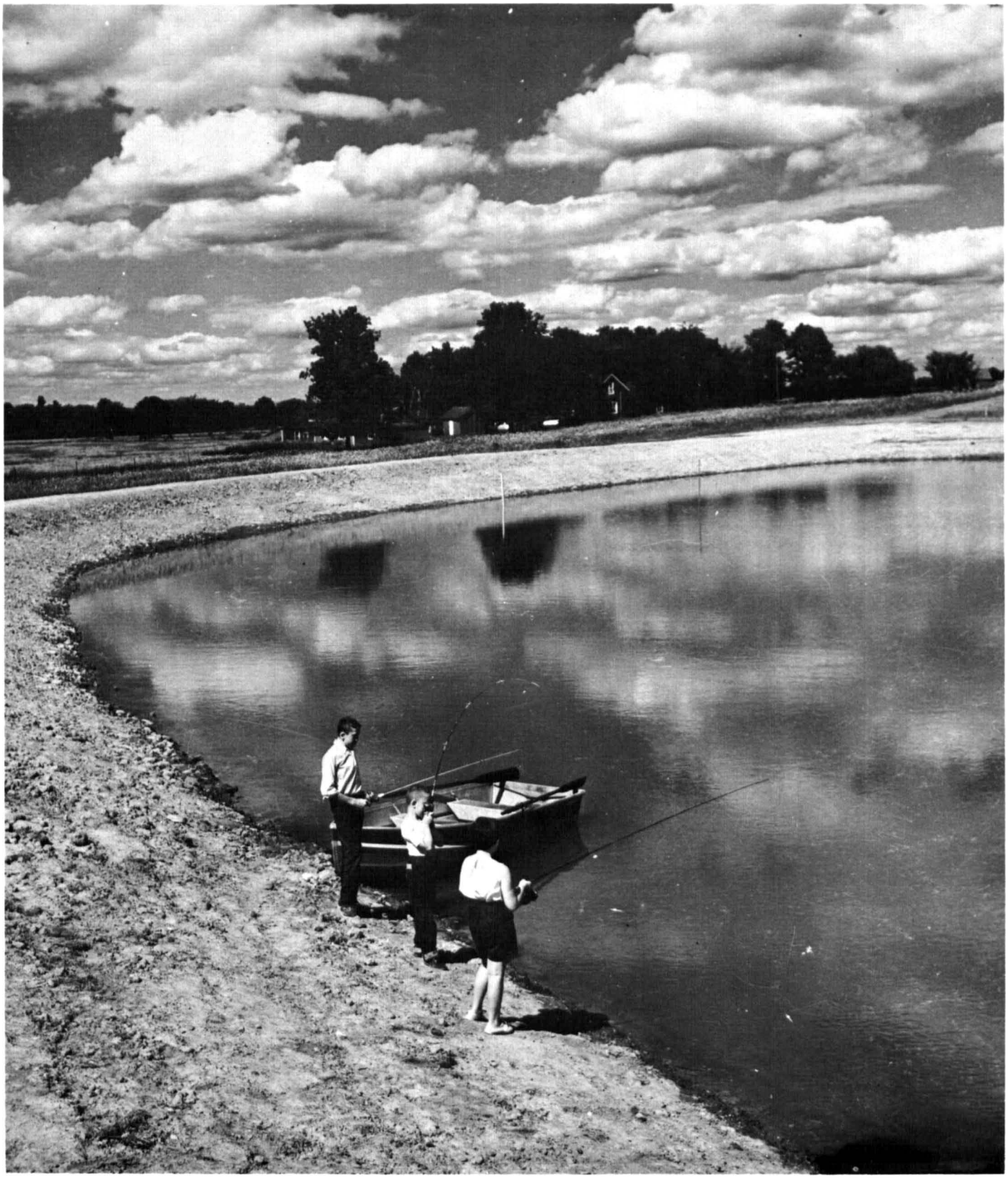


Figure 2.—**Farm pond in Capac loam controls runoff and provides recreation.**

Figure 3.—**Broad areas of nearly level Capac and Parkhill soils on association 2 require drainage.**

nance of tilth is also a problem. The few small woodlots are mostly in undrained areas, and most are pastured.

4. Boyer-Marlette-Houghton association

Well drained and moderately well drained, gently sloping to steep loamy sands to loams on moraines and very poorly drained muck in depressions

This soil association is on rolling to hilly morainic uplands. Swampy depressions and small lakes are numerous. The topography is complex. Hilltops are gently sloping to strongly sloping. Slopes next to depressions are short and steep (fig. 4).

This association makes up about 6 percent of the county. It is about 40 percent Boyer soils, 20 percent Marlette soils, 15 percent Houghton soils, and 25 percent minor soils.

The well drained, gently sloping to steep Boyer soils dominate the uplands. The surface layer is dark grayish brown loamy sand 7 inches thick. The subsurface is 5 inches of brown loamy sand. The upper 6 inches of the subsoil is yellowish brown, very friable loamy sand. The lower 16 inches is brown, firm sandy loam and light sandy clay loam. At a depth of 34 inches is grayish brown, stratified gravel and sand.

The well drained and moderately well drained Marlette soils are intermingled with Boyer soils. The surface layer is very dark grayish brown loam 5 inches thick. The subsurface layer is 9 inches of pale brown loam. The upper 6 inches of the subsoil is yellowish brown, firm light clay loam and pale brown, friable loam. The next 8 inches is brown, firm clay loam. The lower 10 inches is brown, very firm clay loam. At a depth of 38 inches is pale brown, calcareous light clay loam.

The very poorly drained Houghton soils are in depressions interspersed throughout the uplands (fig. 5). They are muck to a depth of 60 inches or more. The surface layer is black, is well decomposed, and is 9 inches thick. The next 4 inches is black, the next 11 inches dark reddish brown, the next 8 inches black, and the lower 34 inches dark reddish brown.

Minor in this association are Spinks, Oshtemo, Metamora, Selfridge, Gilford, Granby, Wasepi, Sebewa, Adrian, Washtenaw, and Wallkill soils. Spinks and Oshtemo soils are intermixed with Boyer and Marlette soils. Metamora and Selfridge soils are on foot slopes and in depressions. Gilford, Granby, Wasepi, and

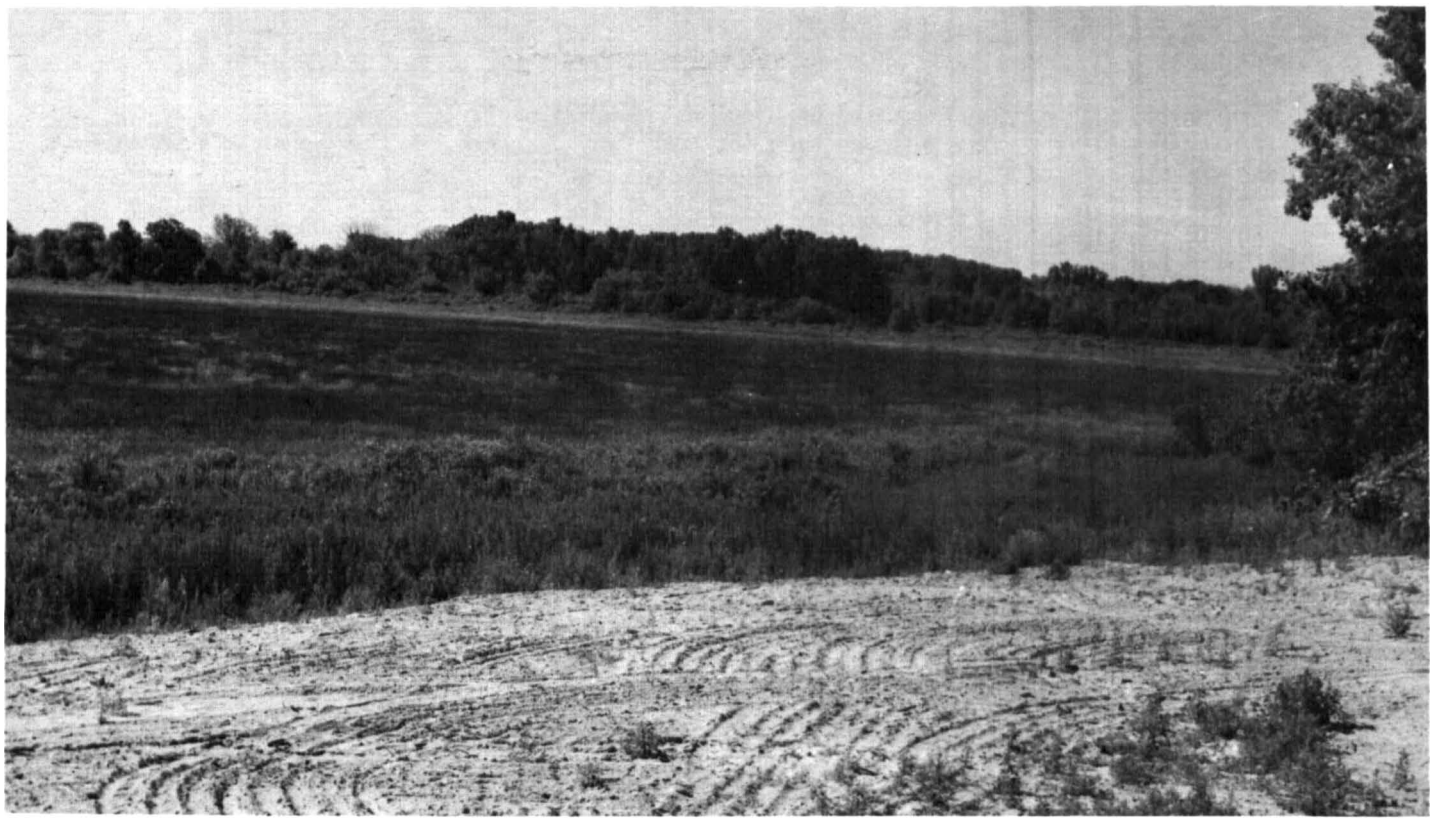


Figure 4.—Gently sloping upland areas of Boyer soils on association 4 break abruptly to deep wet depressions of Houghton muck.

Sebewa soils are in drainageways. Adrian, Washtenaw, and Wallkill soils are in wet depressions.

On the uplands are large dairy farms, general farms, small hobby farms, rural homes, and wooded tracts. Some of the largest wooded areas are on Houghton soils. The gently sloping and sloping soils are suited to farming, but controlling erosion and maintaining tilth are problems. Boyer soils have low available water capacity. Some of the wet soils are difficult to drain because they lack outlets.

Recreation is an important and growing land use. The Rose Lake Wildlife Research Station, a division of the Michigan Department of Natural Resources, is on this association. The proximity of a large and mobile urban population places increased demands upon its resources.

5. *Boyer-Wasepi-Spinks association*

Well drained and somewhat poorly drained, nearly level to moderately steep loamy sands and sandy loams on outwash plains, on terraces, and in old glacial drainageways

This soil association is on broad, nearly level and gently sloping outwash plains and terraces and side slopes along major drainageways and on narrow bottom lands of the drainageways.

This association makes up about 8 percent of the county. It is about 40 percent Boyer soils, 25 percent Wasepi soils, 15 percent Spinks soils, and 20 percent minor soils.

The well drained Boyer soils are on the nearly level and gently sloping outwash plains and terraces and in the sloping and moderately steep areas next to major streams. The surface layer is dark grayish brown loamy sand 7 inches thick. The subsurface layer is 5 inches of brown loamy sand. The upper 6 inches of the subsoil is yellowish brown, very friable loamy sand. The lower 16 inches is brown, firm sandy loam and light sandy clay loam. At a depth of 34 inches is grayish brown stratified gravel and sand.

The somewhat poorly drained Wasepi soils are on nearly level and gently sloping outwash plains and terraces and in drainageways. The surface layer is very dark grayish brown sandy loam 8 inches thick. The subsurface layer is 3 inches of brown sandy loam. The upper 4 inches of the subsoil is dark yellowish brown, very friable light sandy loam. The next 18 inches is yellowish brown, friable sandy loam and dark yellowish brown, firm heavy sandy loam. The lower 4 inches is yellowish brown loose sand. At a depth of 37 inches is grayish brown stratified sand and gravel.

The well drained Spinks soils are on the nearly level and gently sloping outwash plains and terraces and in the sloping areas next to stream bottoms and drainageways, in association with Boyer soils. The surface layer is dark brown loamy sand 8 inches thick. The upper 11 inches of the subsoil is dark yellowish brown loose

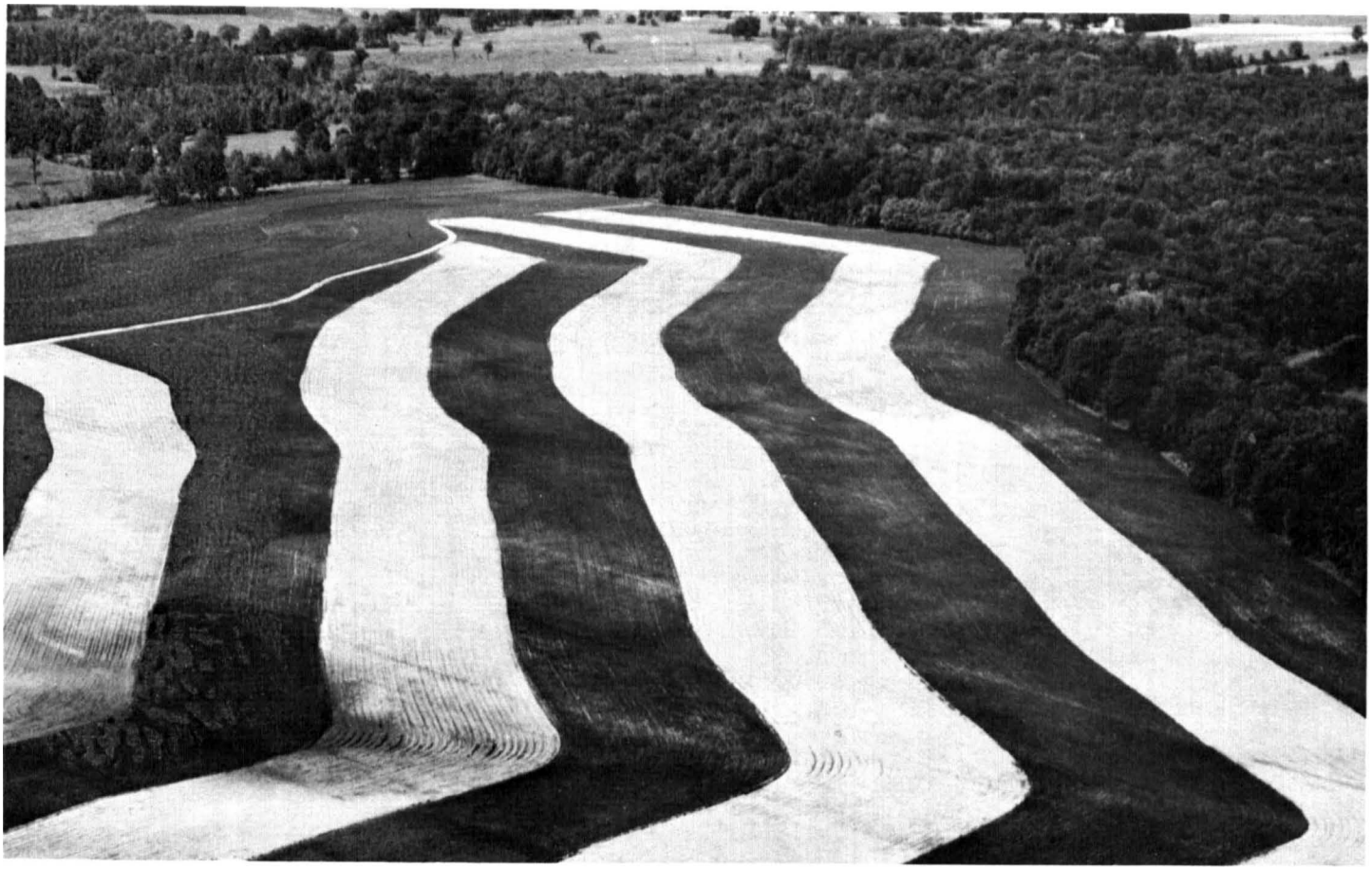


Figure 5.—**Contour strips protect the sloping areas of Marlette soils. The wooded area is Houghton muck.**

sand. The lower 35 inches is brown loose sand that has bands of strong brown, very friable sandy loam. At a depth of 54 inches is pale brown sand.

Minor in this association are Oshtemo, Oakville, Cohoctah, Sloan, Gilford, and Sebewa soils. The Oshtemo and Oakville soils are intermixed with Boyer and Spinks soils. Cohoctah, Sloan, Gilford, and Sebewa soils are along streams.

The nearly level and gently sloping areas of this association are used for general farming. The soils are moderately well suited to cultivated crops. Low available water capacity, low fertility, and soil blowing are the major problems on Boyer and Spinks soils. Wetness is a problem on Wasepi soils. The sloping and moderately steep areas along streams are used mainly for hay, pasture, or woodland. Some former cropland has been planted to pines. There are several commercial gravel pits in this association.

6. *Sebewa-Matherton-Boyer association*

Very poorly drained to somewhat poorly drained, nearly level loams in depressions and well drained, gently sloping loamy sands on terraces

This association is in an old, slightly depressed glacial drainageway that bisects Clinton County. Stoney Creek and the Little Maple River are in the association.

This association makes up about 4 percent of the county. It is about 45 percent Sebewa soils, 25 percent Matherton soils, 10 percent Boyer soils, and 20 percent minor soils.

The very poorly drained and poorly drained Sebewa soils are in depressions. The surface layer is black loam 11 inches thick. The subsoil is gray, firm, mottled loam, clay loam, and gravelly clay loam 28 inches thick. At a depth of 39 inches is grayish brown gravel and sand.

The nearly level, somewhat poorly drained Matherton soils are on foot slopes adjacent to and slightly higher than Sebewa soils. The surface layer is very dark brown loam 8 inches thick. The subsurface layer is 5 inches of light brownish gray, mottled sandy loam. The upper 5 inches of the subsoil is grayish brown, firm, mottled sandy clay loam. The next 10 inches is very firm, mottled clay loam. The lower 4 inches is dark yellowish brown, very firm, mottled clay loam. At a depth of 32 inches is calcareous, mottled, pale brown coarse sand and gravel.

The well drained, gently sloping Boyer soils are on terraces along drainageways. The surface layer is dark grayish brown loamy sand 7 inches thick. The subsurface layer is 5 inches of brown loamy sand. The upper

6 inches of the subsoil is yellowish brown, very friable loamy sand. The lower 16 inches is brown, firm sandy loam and light sandy clay loam. At a depth of 34 inches is grayish brown stratified gravel and sand.

Minor in this association are Gilford, Colwood, Adrian, Wasepi, Spinks, Owosso, Metamora, and Selfridge soils. Gilford and Colwood soils are on low flats. Adrian soils are in depressions. Wasepi, Spinks, and Owosso soils are in close association with Boyer soils. Metamora and Selfridge soils are on toe slopes.

Most of this association is used for general farming. The soils are moderately well suited to cultivated crops. Wetness is a problem on Sebewa and Matherton soils. Low available water capacity and soil blowing are problems on Boyer soils. Maintaining fertility is a problem on all of the soils. There are a few woodlots in undrained areas, most of which are pastured.

7. *Sloan-Houghton-Cohoctah association*

Poorly drained and very poorly drained, nearly level loams and muck on flood plains

This association is on nearly level flood plains. There are many swales, old oxbows, and marshes and some low, gravelly and bouldery benches that are at a slightly higher elevation than the flood plain.

This association makes up about 2 percent of the county. It is about 55 percent Sloan soils, 20 percent Houghton soils, 15 percent Cohoctah soils, and 10 percent minor soils.

The very poorly drained Sloan soils are in large, irregularly shaped areas on flood plains in close association with Cohoctah soils. The surface layer is very dark gray loam 10 inches thick. The subsoil is friable, gray, mottled silt loam 30 inches thick. At a depth of 40 inches is stratified, gray silt loam, light silty clay loam, and sandy loam.

The very poorly drained Houghton soils are in swales and depressions. They are muck to a depth of 60 inches or more. The surface layer is black, is well decomposed, and is 9 inches thick. The next 4 inches is black, the next 11 inches is dark reddish brown, the next 8 inches is black, and the lower 34 inches is dark reddish brown.

The poorly drained and very poorly drained Cohoctah soils are in large, irregularly shaped areas closely associated with Sloan soils. The surface layer is very dark gray loam 14 inches thick. The upper 11 inches of the underlying material is dark gray, friable, mottled fine sandy loam. The next 4 inches is very dark grayish brown, very friable, mottled loamy sand. The next 7 inches is very dark grayish brown, very friable, mottled sandy loam. At a depth of 36 inches is grayish brown, mottled sandy loam.

Minor in this association are Ceresco, Shoals, Boyer, and Spinks soils. The somewhat poorly drained Ceresco and Shoals soils are on slightly higher positions than Sloan and Cohoctah soils. The well drained Boyer and Spinks soils are on ridges and benches.

Flooding, poor drainage, and stoniness are severe limitations for most uses of the soils. Most areas are covered with trees and grasses and are used for wildlife habitat and recreation. The Maple River State Game area is on this association.

8. *Houghton-Gilford-Adrian association*

Very poorly drained, nearly level muck and sandy loams in old lake basins and in depressed drainageways

This soil association is in old lake basins and dish-shaped depressions in old drainageways.

This association makes up about 4 percent of the county. It is about 40 percent Houghton soils, 25 percent Gilford soils, 20 percent Adrian soils, and 15 percent minor soils.

The Houghton and Adrian soils are in the lowest areas in the association. Houghton soils are muck to a depth of 60 inches or more. The surface layer is black, is well decomposed, and is 9 inches thick. The next 4 inches is black, the next 11 inches is dark reddish brown, the next 8 inches is black, and the lower 34 inches is dark reddish brown. The upper 18 inches of Adrian soils is black muck. Below this is a layer of dark reddish brown, friable muck 7 inches thick. At a depth of 25 inches is mottled, light brownish gray, calcareous sand.

Gilford soils are at the outer rims of basins and depressions. They are at slightly higher elevations than Houghton and Adrian soils. The surface layer is black sandy loam 10 inches thick. The upper 14 inches of the subsoil is gray, friable, mottled sandy loam. The lower 4 inches is gray, very friable, mottled sandy loam. The upper 6 inches of the underlying material is light brownish gray, mottled sand. Below this the underlying material is calcareous, gray, stratified sand and gravel.

Minor in this association are Edwards, Palms, Sebewa, Granby, and Wasepi soils. The very poorly drained Edwards and Palms soils are in depressions in close association with Houghton and Adrian soils. The poorly drained and very poorly drained Sebewa and Granby soils are on positions similar to those of Gilford soils. The somewhat poorly drained Wasepi soils are in slightly higher areas.

Many areas of this association have been cleared and drained for farming. There are general farms and farms that produce vegetable crops, mint, or sod. The water table must be controlled to guard against surface drying and soil blowing and excessive decomposition and settling of the muck. Frost is also a hazard on these low-lying soils. Special fertilizers that include micronutrients are needed for most crops on these soils. Some cleared, undrained areas are in pasture, and some large undrained areas are wooded.

Descriptions of the Soils

This section describes the soil series and mapping units in Clinton County. A soil series is described in detail, and then briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to the underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. Color terms are for moist soil unless otherwise stated. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in the description of the mapping unit, or the differences are apparent in the name of the mapping unit.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Borrow land, for example, does not belong to a soil series, but nevertheless, is listed in alphabetic order along with the soil series.

Preceding the name of each mapping unit is a symbol that identifies the mapping unit on the detailed soil map. Listed at the end of each description of the mapping unit is the capability unit, Michigan soil management group (shown in parentheses), woodland suitability group, and woody plant group in which the mapping unit has been placed. For the soil complex mapping units the soil management groups are listed in the same order as the named series. These groups are used for making recommendations about applications of lime and fertilizer, about artificial drainage, and about other practices. For an explanation of these groups refer to "Fertilizer Recommendations for Michigan Vegetable and Field Crops", Extension Bulletin E–550, Michigan State University (*4*). The description of each capability unit can be found by referring to the section "Management by Capability Units."

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the "Glossary" at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*5*).

A comparison of the detailed soil map of this county with those of adjoining counties published at earlier dates will show areas where soil boundaries and symbols do not match perfectly. Such differences are the result of differences in mapping and of changes in classification by soil series.

Adrian Series

The Adrian series consists of nearly level to slightly depressional, very poorly drained soils. These soils

TABLE 1.—*Approximate acreage and proportionate extent of soils*

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Adrian muck	4,970	1.4	Metamora-Capac sandy loams, 0 to 4 percent slopes	11,770	3.2
Blount loam, 0 to 2 percent slopes	6,125	1.8	Metea loamy sand, 2 to 6 percent slopes	2,140	.6
Blount loam, 2 to 6 percent slopes	10,020	2.8	Morley loam, 2 to 6 percent slopes	2,830	.8
Borrow land	550	.1	Morley loam, 6 to 12 percent slopes	485	.1
Boyer sandy loam, 0 to 6 percent slopes	9,970	2.8	Oakville fine sand, 0 to 6 percent slopes	1,035	.3
Boyer sandy loam, 6 to 12 percent slopes	1,995	.5	Oshtemo sandy loam, 2 to 6 percent slopes	700	.2
Boyer complex, 0 to 6 percent slopes	10,870	3.0	Owosso sandy loam, 0 to 2 percent slopes	325	.1
Boyer complex, 6 to 12 percent slopes	1,630	.4	Owosso-Marlette sandy loams, 2 to 6 percent slopes	9,580	2.7
Boyer complex, 12 to 18 percent slopes	1,105	.3	Owosso-Marlette sandy loams, 6 to 12 percent slopes	1,700	.5
Boyer complex, 18 to 25 percent slopes	485	.1	Palms muck	3,865	1.0
Capac loam, 0 to 4 percent slopes	84,770	22.8	Parkhill loam	31,890	8.8
Capac-Marlette loams, 1 to 6 percent slopes	21,540	5.6	Sebewa loam	7,330	2.0
Ceresco fine sandy loam	1,450	.4	Selfridge loamy sand, 0 to 4 percent slopes	1,670	.5
Cohoctah loam	2,030	.5	Shoals loam	1,340	.4
Colwood loam	5,515	1.6	Sims silty clay loam	16,440	4.5
Corunna sandy loam	3,580	1.1	Sisson fine sandy loam, 2 to 6 percent slopes	680	.2
Edwards muck	425	.1	Sloan loam	4,170	1.1
Gilford sandy loam	6,305	1.8	Spinks loamy sand, 0 to 6 percent slopes	6,080	1.6
Granby loamy sand	790	.2	Spinks loamy sand, 6 to 12 percent slopes	1,305	.4
Houghton muck	16,130	4.5	Spinks cobbly loamy sand, cobbly variant, 0 to 6 percent slopes	735	.2
Kibbie loam, 0 to 3 percent slopes	2,455	.8	Thetford loamy sand, 0 to 3 percent slopes	1,500	.4
Lapeer sandy loam, 2 to 6 percent slopes	790	.2	Wallkill loam	255	.1
Marlette loam, 2 to 6 percent slopes	26,540	7.0	Wasepi sandy loam, 0 to 3 percent slopes	9,085	2.5
Marlette loam, 6 to 12 percent slopes	15,200	4.2	Washtenaw loam	1,590	.4
Marlette loam, 12 to 18 percent slopes	2,190	.6	Miscellaneous acreage shown by special symbols	1,800	.5
Marlette loam, 18 to 25 percent slopes	665	.2	Water	1,440	.4
Marlette clay loam, 6 to 12 percent slopes, severely eroded	1,045	.3	Total	365,440	100.0
Marlette clay loam, 12 to 18 percent slopes, severely eroded	950	.3			
Matherton loam, 0 to 3 percent slopes	3,610	1.1			

formed in organic material 16 to 50 inches thick over sand. They are in old shallow lakebeds and glacial drainageways.

In a representative profile the soil is black muck to a depth of 18 inches. Below this is 7 inches of dark reddish brown, friable muck. The underlying material, at a depth of 25 inches, is mottled light brownish gray, calcareous sand.

Runoff is very slow to ponded. Permeability is moderately slow to moderately rapid in the organic material and rapid in the underlying mineral soil. Available water capacity is high.

Adrian soils are well suited to special crops if wetness and the hazards of frost and soil blowing can be overcome. Limitations are severe for most nonfarm uses.

Representative profile of Adrian muck in a cultivated area approximately 1,335 feet east and 300 feet north of the southwest corner of sec. 28, T 8 N., R. 2 W.

Oa1—0 to 8 inches; black (N 2/0 broken face and rubbed) sapric material; about 5 percent fiber, less than 5 percent rubbed; moderate fine granular structure; friable; fibers are herbaceous; many fine roots; medium acid; clear wavy boundary.

Oa2—8 to 18 inches; black (N 2/0 broken face), (10YR 2.5/1 rubbed) sapric material; about 5 percent fibers, less than 2 percent rubbed; weak coarse subangular blocky parting to moderate medium subangular blocky structure; friable; fibers primarily herbaceous; white (N 8/0) mycelium network along root channels and surfaces of peds; medium acid; clear wavy boundary.

Oa3—18 to 25 inches; dark reddish brown (5YR 2/2 broken face), dark brown (7.5YR 3/2 rubbed) sapric material; 10 percent fiber, less than 2 percent rubbed; weak medium platy structure; friable; fiber ghosts in horizons are yellowish red (5YR 4/8); approximately 15 percent mineral material in lower 1 inch of horizon; slightly acid; abrupt wavy boundary.

IICg—25 to 60 inches; light brownish gray (10YR 6/2) sand; few medium distinct yellowish brown (10YR 5/6) mottles; single grained; loose; 5 percent pebbles; slight effervescence; moderately alkaline.

The organic material is dominantly 20 to 40 inches thick, but ranges from 16 to 50 inches. It is primarily herbaceous. Some soils are as much as 30 percent decomposed woody material. Reaction in the organic material ranges from medium acid to neutral. The sandy underlying material is neutral to moderately alkaline. It is not effervescent in all profiles.

The Oa horizon is dominantly black (N 2/0 or 10YR 2/1). Herbaceous fiber ghosts may be as much as 20 percent, but constitute less than 10 percent after rubbing. A 1- or 2-inch layer of limnic material, including sedimentary peat, and marl is in the subsurface or bottom tier in some profiles. The IIC horizon is dominantly sand or gravel or both, or loamy sand.

Adrian soils are similar to Edwards, Palms, and Houghton soils. They are underlain by sandy material within a depth of 50 inches, whereas Palms soils are underlain by loam material and Edwards soils are underlain by marl. Houghton soils formed in organic deposits greater than 50 inches thick.

Ad—Adrian muck. This nearly level to slightly depressional soil is in old shallow lakebeds and glacial drainageways. Individual areas range from about 5 to more than 100 acres in size. In places they are at the outer margin of deeper organic deposits and are crescent in shape. In other areas they are irregular in shape. Slopes are 0 to 2 percent.

Included with this soil in mapping are soils that have less than 16 inches of organic material overlying the sand. Also included are small areas of soils that have thin layers of marl just above the sandy underlying material.

Wetness, the hazard of frost, the hazard of soil blowing, and the poor stability of the organic material are the main limitations. Drainage is needed for most crops. Adequate drainage may be difficult because of the lack of outlets and the unstable nature of the organic material. Many areas have been cleared, drained, and farmed. If problems can be overcome or controlled, this soil is well suited to vegetable crops and special crops, such as mint and grass sod. Small areas are used mainly for corn and soybeans. Other undrained areas are pastured. Many areas are in slow-growing, shallow-rooted, poor-quality lowland hardwoods. This soil has severe limitations for most nonfarm uses. Capability unit IVw–1(M/4c); woodland suitability group 4w2; woody plant group 1.

Blount Series

The Blount series consists of nearly level to gently sloping, somewhat poorly drained soils on broad till plains and lake plains. These soils formed in calcareous loamy glacial till.

In a representative profile the surface layer is dark grayish brown loam about 9 inches thick. The upper 7 inches of the subsoil is grayish brown, firm, mottled clay loam. The next 10 inches is yellowish brown, very firm, mottled silty clay. The lower 5 inches is yellowish brown, firm, mottled silty clay loam. At a depth of 31 inches is gray, calcareous silty clay loam.

Runoff is medium to slow. Permeability is moderately slow or slow. Available water capacity is high.

Blount soils are well suited to farming if they are adequately drained. They are severely limited for most nonfarm uses.

Representative profile of Blount loam, 2 to 6 percent slopes, in a cultivated area 570 feet east and 40 feet north of the southwest corner of sec. 24, T. 7 N., R. 4 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) loam; moderate medium granular structure; friable; 2 percent pebbles; neutral; abrupt smooth boundary.

B21tg—9 to 16 inches; grayish brown (10YR 5/4) clay loam; many medium distinct yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; firm; thin continuous grayish brown (10YR 5/2) clay films on surfaces of peds; 3 percent pebbles; slightly acid; clear smooth boundary.

B22t—16 to 26 inches; yellowish brown (10YR 5/4) silty clay; many medium distinct grayish brown (2.5Y 5/2) mottles; strong coarse angular blocky structure; very firm thin continuous grayish brown (10YR 5/2) coatings on surfaces of peds; 3 percent pebbles; slightly acid; clear wavy boundary.

B23t—26 to 31 inches; yellowish brown (10YR 5/4) heavy silty clay loam; many fine distinct grayish brown (2.5Y 5/2) mottles; moderate coarse angular blocky structure; firm; thin continuous dark grayish brown (10YR 4/2) coatings on surfaces of peds; 4 percent pebbles; neutral; clear wavy boundary.

Cg—31 to 60 inches; gray (10YR 5/1) silty clay loam; many fine distinct yellowish brown (10YR 5/6) mottles; massive; firm; light gray (10YR 7/1) lime streaks; 4 percent pebbles; slight effervescence; mildly alkaline.

The solum ranges from 20 to 40 inches in thickness. The thickness of the solum coincides with the depth to effervescent material. Pebble content ranges from 1 to 6 percent

throughout the pedon. The Ap horizon is dark grayish brown (10YR 4/2) or dark gray (10YR 4/1) and is 6 to 9 inches thick. The A1 horizon, where present, is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) loam. In places there is an A2 horizon.

The B21t horizon is grayish brown (10YR 5/2), yellowish brown (10YR 5/4-5/6), or dark yellowish brown (10YR 4/4) and has yellowish brown (10YR 5/4), grayish brown (2.5Y 5/2), olive gray (5Y 5/2), or gray (5Y 6/1) mottles. It is clay loam or silty clay loam. It is slightly acid or medium acid. In places the B21t horizon is replaced by a B and A horizon. The B22t horizon is yellowish brown (10YR 5/4-5/6), brown (10YR 5/3), or grayish brown (10YR 5/2) silty clay, heavy clay loam, or heavy silty clay loam. Reaction is medium acid or slightly acid. The B23t horizon is yellowish brown (10YR 5/4-5/6), brown (10YR 5/3), or grayish brown (10YR 5/2) and has low chroma mottles. It is heavy silty clay loam, clay loam, or silty clay.

The C horizon is clay loam or silty clay loam. Effervescence ranges from slight to strong.

Reaction in the upper part of the solum is outside the defined range of the series, but this difference does not alter use and management of the soil.

Blount soils in most places are near Capac, Morley, and Sims soils. They have a finer textured subsoil than Capac soils. They are mottled throughout the subsoil, whereas Morley soils are mottled only in the lower part of the subsoil. Blount soils have brown colors in the solum, whereas Sims soils have gray colors. Also, they lack the dark colored surface layer typical of Sims soils.

BdA—Blount loam, 0 to 2 percent slopes. This nearly level soil is on till plains and lake plains. Individual areas range from 3 to more than 100 acres in size. This soil has a profile similar to the one described as representative of the series, but the subsoil is thicker.

Included with this soil in mapping are areas of soils that have thin bands of silty or sandy material in the subsoil and substratum. Also included are small areas of Sims soils that are in slight depressions and narrow drainageways, areas of soils that have 18 to 24 inches of sandy loam overlying the silty clay loam substratum, and a few small areas of Corunna soils. Small deep sandy areas and wet areas less than 3 acres in size are identified by spot symbols on the soil map.

Wetness is the main problem of this soil for farming. The soil is well suited to corn, soybeans, and other crops, but it must be adequately drained.

Most areas of this soil are farmed. Wooded areas are in poor stands of hardwoods, and many have been heavily pastured. This soil has severe limitations for most nonfarm uses. Capability unit IIw–1(1.5b); woodland suitability group 2o4; woody plant group 2.

BdB—Blount loam, 2 to 6 percent slopes. This gently sloping soil is on broad till plains. Slopes are dominantly less than 200 feet long. Individual areas of this soil range from about 5 to more than 100 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of steeper Morley soils. Also included are Sims soils in small narrow drainageways. Wet areas and sandy areas of less than 3 acres are identified by spot symbols on the soil map.

Wetness and the erosion hazard are the main limitations of this soil for farming. If drainage is adequate and erosion is controlled, this soil is well suited to corn, soybeans, and other adapted crops. Most areas are farmed. Wooded areas are in poor-quality hardwoods. Many areas are pastured. This soil has severe limitations for most nonfarm uses. Capability unit IIe–4 (1.5b); woodland suitability group 2o4; woody plant group 2.

Borrow Land

Bh—Borrow land consists of areas where soil material has been removed to variable depths. The original soil profiles have been destroyed. The areas range in size from 3 to 30 acres.

The soil material in the areas of Borrow land is sand, loamy sand, gravelly sand, sandy loam, loam, and clay loam. Content of organic matter is low. A few areas are subject to intermittent ponding. Most areas support a very sparse stand of native grasses and weeds. Capability unit VIIs–1; no Michigan soil management group; not assigned to a woodland suitability group or woody plant group.

Boyer Series

The Boyer series consists of nearly level to steep, well drained soils on outwash plains, terraces, and moraines. These soils formed in loamy and sandy glaciofluvial deposits.

In a representative profile the surface layer is dark grayish brown loamy sand about 7 inches thick. The subsurface layer is brown loamy sand 5 inches thick. The upper 6 inches of the subsoil is yellowish brown, very friable loamy sand. The lower 16 inches is brown, firm sandy loam and light sandy clay loam. The underlying material, at a depth of 34 inches, is grayish brown, stratified gravel and sand.

Permeability is moderately rapid. Runoff is slow to rapid. Available water capacity is low.

Boyer soils are moderately well suited to farming, but droughtiness and the hazard of erosion are problems. These soils have slight to severe limitations for most nonfarm uses. They are a potential source of sand and gravel.

Representative profile of Boyer loamy sand, from an area of Boyer complex, 0 to 6 percent slopes; in a cultivated field 1,090 feet south and 450 feet west of the northeast corner of sec. 6, T. 5 N., R. 1 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loamy sand; weak fine granular structure; very friable; abundant roots; 2 percent pebbles; slightly acid; abrupt smooth boundary.

A2—7 to 12 inches; brown (10YR 5/3) loamy sand; weak medium granular structure; very friable; many fine roots; 2 percent pebbles; medium acid; clear wavy boundary.

B1—12 to 18 inches; yellowish brown (10YR 5/4) loamy sand; weak fine subangular blocky structure; very friable; few fine roots; 4 percent pebbles; medium acid; clear wavy boundary.

B21t—18 to 30 inches; brown (7.5YR 4/4) sandy loam; weak coarse subangular blocky structure; firm; few fine roots; few thin clay films; 15 percent pebbles; slightly acid; gradual wavy boundary.

B22t—30 to 34 inches; brown (7.5YR 4/4) light sandy clay loam; weak coarse subangular blocky structure; firm; common thin and medium clay films; 15 percent pebbles; neutral; abrupt irregular boundary.

IIC—34 to 60 inches; grayish brown (10YR 5/2) stratified gravel and sand; single grained; loose; strong effervescence; moderately alkaline.

The solum ranges from 24 to 40 inches in thickness. The thickness of the solum coincides with the depth to effervescent soil material. Pebble content ranges from 1 to 25 per-

cent throughout the solum.

The A horizon is dark grayish brown (10YR 4/2), brown (10YR 4/3, 5/3), or yellowish brown (10YR 5/4). In places there is a very dark grayish brown (10YR 3/2) or dark brown (10YR 3/3) A1 horizon.

The B horizon is dark yellowish brown (10YR 4/4), brown (7.5YR 4/4, 5/4), reddish brown (5YR 4/4), yellowish brown (10YR 5/4), or strong brown (7.5YR 5/6).

Boyer soils in most places are near Lapeer, Oshtemo, and Spinks soils. They have a coarser textured substratum than Lapeer soils and a thinner solum than Oshtemo soils. Boyer soils have a thinner and finer textured solum than Spinks soils. Also, they have more gravel in the underlying material than Spinks soils.

BnB—Boyer sandy loam, 0 to 6 percent slopes. This nearly level and gently sloping soil is on outwash plains, terraces, and moraines. Individual areas range from less than 5 to more than 100 acres in size. Most areas on outwash plains are large and are irregular in shape, whereas areas on terraces and moraines are smaller and are long and narrow. This soil has a profile similar to the one described as representative of the series, but the surface layer is sandy loam.

Included with this soil in mapping are areas where the upper 24 to 36 inches of the soil is sandy clay loam and clay loam and areas of Wasepi and Matherton soils in small depressions and narrow waterways. Also included are wet areas, gravel pits, and small loamy areas that are less than 3 acres in size, all of which are identified by spot symbols on the soil map.

Soil blowing and droughtiness are the main problems of this soil for farming. The soil is moderately well suited to farming, and most areas are cultivated. Crops commonly grown are corn, soybeans, field beans, oats, wheat, and grass-legume hay. A few areas are idle or wooded. This soil has few problems for most nonfarm uses. A few areas are used as a source of gravel. Capability unit IIIs–1(4a); woodland suitability group 2s5; woody plant group 3.

BnC—Boyer sandy loam, 6 to 12 percent slopes. This sloping soil is on terraces, on side slopes bordering large drainageways, and on moraines. Individual areas of this soil range from about 5 to 40 acres in size. Most areas are long and narrow. This soil has a profile similar to the one described as representative of the series, but the surface layer is sandy loam.

Included with this soil in mapping are small areas of soils that are sandy clay loam and clay loam in the upper 24 to 36 inches of the profile. Also included are areas of Marlette soils that are near the crests of slopes on moraines; small narrow drainageways, depressions, and foot slopes of Wasepi and Matherton soils; and small eroded areas of soils near the crests of slopes. Wet spots and gravel pits less than 3 acres in size are identified by spot symbols on the soil map.

Slope, droughtiness, and an erosion hazard are the main limitations of this soil for farming. Most areas have been cleared and farmed. A few are idle or wooded. A few are sources of sand and gravel. This soil is only moderately well suited to farming. Crops commonly grown are corn, field beans, soybeans, wheat, oats, and grass-legume hay. Limitations are moderate for many nonfarm uses. Capability unit IIIe–4(4a); woodland suitability group 2s5; woody plant group 3.

BoB—Boyer complex, 0 to 6 percent slopes. The nearly level and gently sloping soils in this complex are Boyer loamy sand and Boyer sandy loam. They are on outwash plains and gravelly terrace benches adjacent to major drainageways. Individual areas range from about 5 to more than 160 acres in size; most are 10 to 40 acres in size. Most of the areas next to drainageways are long and narrow. Most areas on outwash plains are irregular in shape.

Boyer loamy sand and Boyer sandy loam are in areas too small and intricately associated to be mapped separately. The soil that has the profile described as representative of the Boyer series is in this unit. This complex is 35 percent Boyer loamy sand, 35 percent Boyer sandy loam, and about 30 percent minor soils.

Included with this complex in mapping are small areas of Wasepi soils in drainageways, depressions, and in places where this unit borders wet soils. Also included are areas of soils where layers of silt loam are in the underlying material and a few small severely eroded areas.

Droughtiness and the hazard of erosion are the main limitations for farming. The soils in this complex are moderately well suited to cultivated crops. Most areas are cleared and cultivated. Some are idle. Crops grown are corn, beans, oats, wheat, and grass-legume hay. A few areas are used as native pasture or remain in an oak-hickory forest. The soils of this complex have few problems for most of the nonfarm uses. A few areas serve as a source of sand and gravel. Capability unit IIIs–1(4a); woodland suitability group 2s5; woody plant group 3.

BoC—Boyer complex, 6 to 12 percent slopes. The sloping soils in this complex are Boyer loamy sand and Boyer sandy loam. They are on terraces, outwash plains, and the sides of major drainageways. Areas range from 3 to 40 or more acres in size. Most areas along drainageways are long and narrow, and most areas on outwash plains are irregular in shape.

Boyer loamy sand and Boyer sandy loam are adjacent in areas too small and intricately associated to be mapped separately. The soils in this unit have profiles similar to the one described as representative of the series, but the subsoil is thinner. This complex is about 35 percent Boyer loamy sand, 25 percent Boyer sandy loam, and 40 percent minor soils. The Boyer loamy sand is generally on the upper part of the soil areas and the Boyer sandy loam on the lower part of slopes.

Included with this complex in mapping are Wasepi soils in small, narrow drainageways and depressions and a few severely eroded areas at the crest of slopes. Wet spots and gravel pits that are less than 3 acres in size are identified by spot symbols on the soil map.

Slope, droughtiness, and the hazard of erosion are the main limitations for farming. Cultivated crops are only moderately well suited. Most areas have been cleared and cultivated, but are now idle. A few areas are used for wheat, oats, and forage crops. Others are wooded with oak and hickory. Limitations are moderate to severe for many nonfarm uses. In places the soils of this complex are sources of sand and gravel. Capability unit IIIe–4(4a); woodland suitability group 2s5; woody plant group 3.

BoD—Boyer complex, 12 to 18 percent slopes. The moderately steep soils in this complex are Boyer loamy sand and Boyer sandy loam. This complex is on moraines, terraces, and the sides of major drainageways.

Individual areas range from 2 to about 20 acres in size. In the moraines they are on rounded or irregular shaped knolls and ridges. On sides of drainageways and terraces they are long and narrow. Slopes rarely exceed 200 feet in length.

The soils of this complex are adjacent in areas too small and intricately associated to be mapped separately. The soils in this mapping unit have profiles similar to the one described as representative for the series except the surface layer is thinner. This complex is about 45 percent Boyer loamy sand, about 25 percent Boyer sandy loam, and about 30 percent minor soils. Boyer loamy sand is on the upper part of slopes. Boyer sandy loam is on the sides and foot slopes and in the slight depressions.

Included with this complex in mapping are small areas of Owosso and Marlette soils and small areas of Wasepi soils in small, narrow drainageways. Wet, seepy spots and gravel pits less than 3 acres in size are identified by spot symbols on the soil map.

Droughtiness and the hazard of erosion are the major limitations for farming. Most areas are idle or wooded. A few are used as native pasture or are cultivated. This complex is poorly suited to farming. Tillage and harvesting are hindered by moderately steep slopes, and cultivated crops are limited to small grain and grass-legume hay. Limitations are severe for most nonfarm uses. A few areas are used as a source of sand and gravel. Capability unit IVe–3 (4a); woodland suitability group 2s5; woody plant group 3.

BoE—Boyer complex, 18 to 25 percent slopes. The soils in this complex are Boyer loamy sand and Boyer sandy loam. They are on short, steep slopes that border drainageways and wet depressions. Individual areas range from 3 to about 20 acres in size. Slopes are generally 100 to 200 feet long.

The soils of this complex are adjacent in areas too small and intricately associated to be mapped separately. They have a profile similar to the one described as representative of the series, but the surface layer and subsoil are thinner. This complex is about 55 percent Boyer loamy sand, which is on the upper part of the side slopes; 25 percent Boyer sandy loam, which is at mid slope and on foot slopes; and 20 percent minor soils. Included in mapping are small areas of Owosso and Marlette soils on the upper side slopes and a few severely eroded areas that are steeper than is typical.

Slope, droughtiness, and the hazard of erosion are the major limitations for farming. Most areas are idle or wooded. A few areas are used for pasture or for legume-grass hay. This complex is not suited to farming because steep slopes restrict the use of tillage and harvesting equipment and the soils are very easily eroded if exposed to wind and water. Limitations are severe for nonfarm uses. Capability unit VIe–3 (4a); woodland suitability group 2s6; woody plant group 3.

Capac Series

The Capac series consists of nearly level to gently sloping, somewhat poorly drained soils on broad till plains and moraines. These soils formed in calcareous loamy glacial till.

In a representative profile (fig. 6) the surface layer is dark brown loam 9 inches thick. The subsoil is 22 inches thick. It is yellowish brown, friable, mottled clay loam and pale brown loam in the upper 3 inches; yellowish brown, friable, mottled light clay loam in the next 8 inches; and yellowish brown, friable, mottled

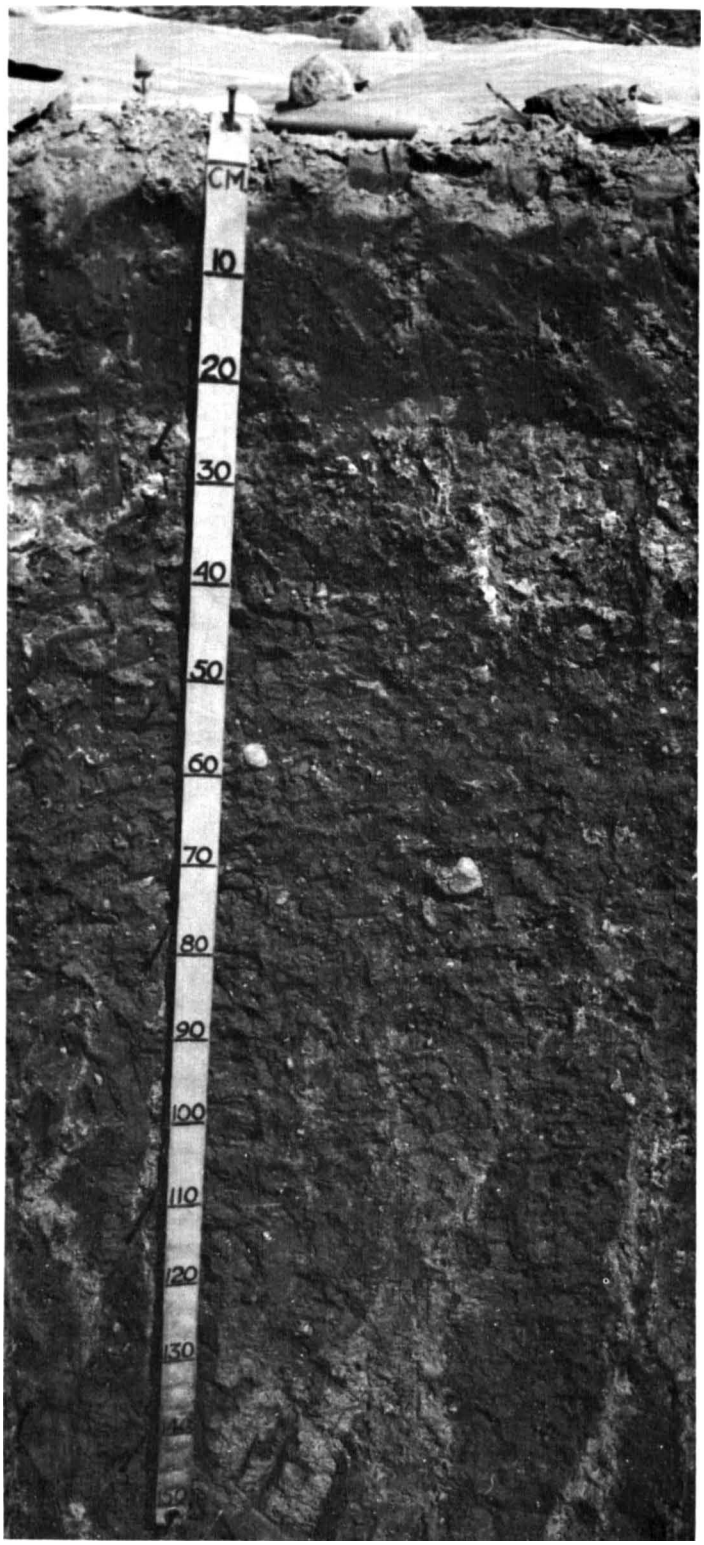


Figure 6.—**Representative profile of Capac loam.**

light clay loam in the lower 11 inches. Below this, at a depth of 31 inches, is yellowish brown loam that has mottles.

Runoff is medium to slow. Permeability is moderate and moderately slow. Available water capacity is high.

Capac soils are well suited to farming if they are adequately drained. They are severely limited for most nonfarm uses.

Representative profile of Capac loam, 0 to 4 percent slopes, in a cultivated area 2,140 feet west and 400 feet north of the southeast corner of sec. 5, T. 7 N., R. 1 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) loam; cloddy separating to moderate fine and medium granular structure; friable; common very fine roots; 5 percent pebbles; medium acid; abrupt smooth boundary.

B&A—9 to 12 inches; yellowish brown (10YR 5/6) light clay loam (B part) and pale brown (10YR 6/3) loam (A part); white (10YR 8/2) dry coatings on surface of peds and along root and worm channels; common fine distinct reddish brown (5YR 4/3) and few fine distinct grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to moderate fine angular blocky; friable; common very fine roots; continuous and grayish brown (10YR 5/2) clay films; peds have pale brown material on vertical faces between abutting peds; matrix is 30 percent material 2 to 10 millimeters thick and 5 percent material 10 to 30 millimeters thick; vertical extension of the pale brown material is through the horizon; black (N 2/0) iron-manganese aggregations; 5 percent pebbles; medium acid; clear wavy boundary.

B21t—12 to 20 inches; yellowish brown (10YR 5/6) light clay loam; common fine distinct greenish gray (5GY 6/1) and common fine faint brown (7.5YR 4/4) mottles; weak medium prismatic structure parting to moderate fine and medium angular blocky; friable; common very fine roots on surfaces of peds; continuous dark grayish brown (10YR 4/2) clay films and many, dark reddish brown (5YR 2/2) and dark brown (7.5YR 3/2) clay organic films; black (N 2/0) iron-manganese aggregations; 5 percent pebbles; slightly acid; clear wavy boundary.

B22t—20 to 31 inches; yellowish brown (10YR 5/6) light clay loam; few fine prominent greenish gray (5GY 6/1) and common fine distinct gray (10YR 5/1), light gray (10YR 6/1), and brown (7.5YR 4/4 and 5/2) mottles; moderate medium angular blocky structure; friable; few very fine roots; many continuous dark grayish brown (10YR 4/2) and brown (7.5YR 4/2) clay films; black (N 2/0) iron-manganese aggregations; 5 percent pebbles; neutral; clear wavy boundary.

C1—31 to 43 inches; yellowish brown (10YR 5/4, 5/6) loam; common fine distinct grayish brown (10YR 5/2) and brown (10YR 4/3) mottles; massive parting to weak medium and very thick platy structure; friable; very few fine roots; 5 percent pebbles; slight effervescence; moderately alkaline; clear irregular boundary.

C2—43 to 60 inches; yellowish brown (10YR 5/4) loam; fine few distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6, 5/8) mottles; massive parting to weak medium platy structure; friable; very few very fine roots; 5 percent pebbles; slight effervescence; moderately alkaline.

The solum is dominantly 26 to 36 inches thick, but ranges from 26 to 40 inches. Pebble content ranges from 1 to 10 percent throughout the solum and the C horizon.

The Ap horizon is dark brown (10YR 3/3), dark grayish brown (10YR 4/2), or very dark grayish brown (10YR 3/2), and has dry colors of light brownish gray (10YR 6/2). A dark gray (10YR 3/1) A1 horizon 2 to 4 inches thick occurs in undisturbed areas. The A2 horizon, where present, is grayish brown (10YR 5/2), light brownish gray (10YR 6/2), pale brown (10YR 6/3), or gray (10YR 5/1, 6/1) loam or sandy loam.

The B part of the B&A horizon is yellowish brown (10YR 5/6, 5/8, 5/4) light clay loam, loam, or light sandy clay loam. The Bt horizon is yellowish brown (10YR 5/4, 5/6, 5/8) or dark yellowish brown (10YR 4/4). Mottles that have chroma of 2 or less are throughout. The Bt horizon is clay loam, sandy clay loam, or heavy loam.

The C horizon is yellowish brown (10YR 5/4), brown (10YR 5/3), or grayish brown (10YR 5/2) loam or light clay loam.

Capac soils on most landscapes are near Marlette, Metamora, Blount, and Kibbie soils. They have a mottled subsoil, which Marlette soils lack, are finer textured in the upper part of the subsoil than Metamora soils, and have a coarser textured subsoil than Blount soils. Capac soils do not have the underlying stratified silt and fine sand characteristic of Kibbie soils.

CaA—Capac loam, 0 to 4 percent slopes. This nearly level and gently sloping soil is on broad till plains of low relief and on moraines. On broad plains, individual areas range from 20 to 160 acres or more in size. Slopes are typically complex and less than 150 feet long. On the moraines, the soil is on nearly level and gently sloping foot slopes. Individual areas on the more sloping uplands range from 3 to approximately 40 acres in size. They are irregular in shape. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Parkhill soils in drainageways and slight depressions and Capac soils that have slopes of 4 to 6 percent on small knolls and short side slopes along drainageways. Sand spots and wet spots that are less than 2 acres in size are identified by spot symbols on the soil map.

Wetness is the main limitation of this soil for farming. Erosion is a hazard in the gently sloping areas. If drainage is adequate and erosion is controlled, this soil is well suited to corn, soybeans, field beans, and other crops. Most areas are farmed. Wooded areas are small and support poor stands of hardwoods. Many areas are pastured. Limitations are severe for many nonfarm uses. Capability unit IIw–1(2.5b); woodland suitability group 2o4; woody plant group 2.

CbB—Capac-Marlette loams, 1 to 6 percent slopes. The undulating soils in this complex are Capac loam and Marlette loam. These soils are adjacent in areas too small and intricately mixed to be mapped separately. Typically, individual areas range from about 10 to 140 acres in size and are irregular in shape. The surface of this complex is uneven. There are many low, short irregular slopes and knolls intermixed with wet pockets and narrow drainageways. This complex is about 45 percent Capac loam in concave areas between low ridges and knolls and about 35 percent Marlette loam on the higher, slightly convex knolls, ridges, and smooth upper side slopes and at the heads of drainageways. Minor soils make up the remaining 20 percent.

Included with this complex in mapping are small areas of Parkhill soils in the same position as the Capac soil. Small wet areas that are less than 3 acres in size are identified by spot symbols on the soil map.

Wetness and the complexity of slopes are the main limitations of these soils. The intricate pattern of varying drainage conditions requires careful design and installation of drainage systems. The soils in this complex are well suited to farming if adequate drainage is provided. Corn, soybeans, wheat, and forage crops are

grown. Harvesting is occasionally delayed by uneven ripening of such crops as soybeans and wheat. Most areas are farmed. A few small areas are wooded with mixed hardwoods. Limitations are severe for most nonfarm uses. Capac soil in capability unit IIw–2(2.5b), woodland suitability group 2o4, woody plant group 2; Marlette soil in capability unit IIw–2 (2.5a), woodland suitability group 2o1, woody plant group 3.

Ceresco Series

The Ceresco series consists of nearly level, somewhat poorly drained soils on flood plains. These soils formed in sandy and loamy material deposited by streams during flooding.

In a representative profile the surface layer is very dark gray sandy loam 10 inches thick. The subsoil is 16 inches thick. The upper 9 inches is dark brown, friable, mottled sandy loam, and the lower 7 inches is dark grayish brown, very friable, mottled loamy fine sand. The underlying material, at a depth of 26 inches, is grayish brown sandy loam.

Runoff is very slow. Permeability in the underlying material is moderate and moderately rapid. Available water capacity is moderate.

Ceresco soils are moderately well suited to row crops if they are drained and protected against flooding. These soils are severely limited for most nonfarm uses.

Representative profile of Ceresco fine sandy loam, in an idle field 400 feet south and 300 feet east of the northwest corner of sec. 26, T. 7 N., R. 4 W.

A1—0 to 10 inches; very dark gray (10YR 3/1) fine sandy loam; weak medium granular structure; friable; neutral; clear wavy boundary.

B1—10 to 19 inches; dark brown (10YR 4/3) light sandy loam; common fine distinct gray (10YR 5/1) mottles; weak medium subangular blocky structure; friable; streaks and void fillings of very dark gray (10YR 3/1) organic matter; neutral; clear wavy boundary.

B2g—19 to 26 inches; dark grayish brown (10YR 4/2) loamy fine sand; common fine faint yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; very friable; mildly alkaline; clear wavy boundary.

Cg—26 to 60 inches; grayish brown (10YR 5/2) sandy loam; massive very friable; moderately alkaline.

Reaction in the solum ranges from slightly acid to mildly alkaline. The material below the solum is calcareous in places.

The A1 horizon ranges from very dark gray (10YR 3/1) to very dark brown (10YR 2/2). In cultivated areas, the Ap horizon is very dark grayish brown (10YR 3/2), very dark gray (10YR 3/1), or very dark brown (10YR 2/2). The A horizon is fine sandy loam and sandy loam. If the Ap horizon or the A1 horizon is loamy fine sand, it is more than 10 inches thick.

The B1 horizon ranges from dark brown (10YR 4/3) or brown (10YR 5/3), to dark yellowish brown (10YR 4/4). The B2 horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2). The B horizon is light sandy loam or loamy fine sand. It is primarily gray, grayish brown, or light brownish gray below a depth of 24 to 30 inches.

The C horizon ranges from sandy loam and fine sandy loam to loamy fine sand that has thin layers of sand or loamy sand.

Ceresco soils in most landscapes are near Cohoctah and Shoals soils. They are browner below the surface layer than Cohoctah soils and have a coarser textured subsoil than Shoals soils.

Ce—Ceresco fine sandy loam. This nearly level soil is on flood plains, where it occupies the natural levees adjacent and parallel to flowing streams. Other areas occur as slightly elevated areas within the flood plain. Slopes are 0 to 2 percent. Included in mapping are a few small areas of Sloan soils.

Wetness and flooding are the major limitations of this soil for farming. Adequate drainage is difficult to obtain because of the lack of outlets. A few areas have been cleared, drained, and are used for growing corn and forage crops. Other undrained areas are in pasture or remain wooded. Limitations are severe for most nonfarm uses. Capability unit IIIw–2 (L–2c); woodland suitability group 2o4; woody plant group 2.

Cohoctah Series

The Cohoctah series consists of nearly level, very poorly drained and poorly drained soils on flood plains. These soils formed in sandy and loamy material deposited by streams during flooding.

In a representative profile the surface layer is very dark gray loam 14 inches thick. The upper part of the underlying material is dark gray, friable, mottled fine sandy loam 11 inches thick. The next 4 inches is very dark grayish brown, very friable, mottled loamy sand, and the next 7 inches is very dark grayish brown, very friable, mottled sandy loam. The lower part, at a depth of 36 inches, is grayish brown, mottled sandy loam.

Runoff is very slow to ponded. Permeability is moderately rapid. Available water capacity is high.

Cohoctah soils are moderately well suited to row crops if they are drained and protected against flooding. These soils are severely limited for most nonfarm uses.

Representative profile of Cohoctah loam in an area of grass and sedges 1,390 feet west of the southeast corner of sec. 33, T. 5 N., R. 3 W.

A1—0 to 14 inches; very dark gray (10YR 3/1) loam; weak fine granular structure; friable; neutral; gradual wavy boundary.

C1g—14 to 25 inches; dark gray (10YR 4/1) fine sandy loam; few fine prominent yellowish red (5YR 4/6) mottles; moderate medium subangular blocky structure; friable; neutral; abrupt wavy boundary.

C2g—25 to 29 inches; very dark grayish brown (10YR 3/2) loamy sand; few fine prominent dark brown (7.5YR 4/4) mottles; weak coarse subangular blocky structure; very friable; neutral; gradual wavy boundary.

C3g—29 to 36 inches; very dark grayish brown (10YR 3/2) sandy loam; few fine prominent dark brown (7.5YR 4/4) mottles; weak coarse subangular blocky structure; very friable; mildly alkaline; abrupt wavy boundary.

C4g—36 to 60 inches; grayish brown (10YR 5/2) sandy loam; common medium distinct strong brown 7.5YR 5/6) mottles; massive; friable; thin (less than 2 inches thick) strata of sand below a depth of 42 inches; mildly alkaline.

Reaction in the upper part of the profile is slightly acid to mildly alkaline and below a depth of 30 inches is mildly alkaline to moderately alkaline.

The A1 horizon ranges from black (10YR 2/1) to dark gray (10YR 4/1) loam or sandy loam. Where present, the B horizon is dominantly gray (10YR 5/1) to very dark grayish brown (10YR 3/2) sandy loam or loam.

In the C horizon hue is 10YR or 7.5YR, value is 3 through 6, and chroma is 1 or 2. The C horizon is sandy loam, loamy sand, fine sandy loam, or loam. Thin layers of sand, loamy fine sand, silt, or silt loam are common. Distribution of organic matter throughout the upper 40 inches of the C horizon is uneven, and a buried A horizon is common.

Cohoctah soils in most landscapes are near Ceresco and Sloan soils. They have grayer color below the surface layer than Ceresco soils and have a coarser textured subsoil than Sloan soils.

Ch—Cohoctah loam. This soil is on low first bottom positions on flood plains along streams. Soil areas are long and narrow and roughly parallel to the stream course. Slopes are 0 to 2 percent. Included in mapping are small areas of soils that have a thin, black, organic surface layer and thin layers of organic material.

Frequency and duration of flooding, a high water table, and frost action are major limitations. This soil is wet and subject to flooding. Most areas are used for native pasture or are wooded with poor-quality trees. Only a limited acreage is used for row crops. Corn is grown year after year in these areas. Limitations are severe for most nonfarm uses. Capability unit IIIw–2 (L–2c); woodland suitability group 2w1; woody plant group 2.

Colwood Series

The Colwood series consists of nearly level, very poorly drained and poorly drained soils on glacial lake plains and in drainageways. These soils formed in loamy material deposited by water.

In a representative profile the surface layer is 8 inches of very dark brown loam and 3 inches of very dark brown light silt loam. The upper 11 inches of the subsoil is gray, friable, mottled heavy silt loam. The lower 12 inches is light brownish gray, firm, mottled light silty clay loam. The underlying material, at a depth of 34 inches, is light brownish gray, calcareous stratified silt loam, silt, fine sand, and sandy loam.

Runoff is very slow to ponded. Permeability is moderate. Available water capacity is very high.

Colwood soils are well suited to farming if they are adequately drained. They are severely limited for most nonfarm uses.

Representative profile of Colwood loam in a cultivated area 1,300 feet north and 515 feet west of the southeast corner of sec. 12, T. 7 N., R. 3 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam; moderate medium granular structure; friable; few fine roots; neutral; abrupt smooth boundary.

A12—8 to 11 inches; very dark brown (10YR 2/2) light silt loam; moderate medium granular structure; friable; few roots; neutral; clear wavy boundary.

B21g—11 to 22 inches; gray (10YR 6/1) heavy silt loam; common fine distinct brownish yellow (10YR 6/6) mottles; moderate fine subangular blocky structure; friable; neutral; gradual wavy boundary.

B22g—22 to 34 inches; light brownish gray (10YR 6/2) light silty clay loam; common fine distinct yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; firm; neutral; clear wavy boundary.

Cg—34 to 60 inches; light brownish gray (2.5Y 6/2) stratified silt loam, silt, fine sand, and sandy loam; many coarse distinct yellowish brown (10YR 5/6) mottles; massive; friable; strong effervescence; moderately alkaline.

The solum is typically 30 to 40 inches thick, but ranges from 24 to 40 inches. Thin layers of gravelly coarse sand, sand, and fine sand are in the lower part of the B horizon and the C horizon in places.

The A horizon is very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), very dark gray (10YR 3/1), or black (10YR 2/1). Reaction is slightly acid to mildly alkaline.

The B horizon is gray (10YR 6/1, 10YR 5/1, 5Y 5/1, 5Y 6/1, 2.5Y 5/0, 6/0), light brownish gray (10YR 6/2, 2.5Y 6/2), grayish brown (10YR 5/2, 2.5Y 5/2), or dark gray (10YR 4/1, 5Y 4/1, 2.5Y 4/0). It is heavy silt loam, loam, or light silty clay loam and has thin layers of fine sand, loamy sand, and sandy loam in places.

Color in the C horizon is similar to that in the B horizon. The C horizon is silt loam, silt, or fine sandy loam and has thin strata of fine sand, loamy sand, loam, clay loam, or silty clay loam.

Colwood soils in most landscapes are near Kibbie, Gilford, and Parkhill soils. They have a gray subsoil, whereas Kibbie soils have a brown subsoil, and they are underlain by fine sand and silt, whereas Gilford soils are underlain by sand and gravel. These soils have a finer textured subsoil than Gilford soils. They formed in water-sorted material, whereas Parkhill soils formed in loamy glacial till. They are more stratified than Parkhill soils.

Co—Colwood loam. This nearly level soil is on broad flats on glacial lake plains and in drainageways. Most areas are round or oblong in shape and range from 2 to approximately 30 acres in size. Typically, they are less than 10 acres in size. Slopes are 0 to 2 percent. Included in mapping are a few small areas where the surface layer is black muck 6 to 12 inches thick.

Wetness, especially early in the growing season, is the main limitation of this soil for farming. Installing drainage can be difficult, and it is best to install drainage during dry periods. Ditchbanks and trench walls are subject to sluffing, and special material is needed to keep fine sand and silt from clogging tile lines. If adequately drained, this soil is well suited to farming. Corn, soybeans, and field beans are the major crops grown. Limitations are severe for most nonfarm uses. Capability unit IIw–3(2.5c); woodland suitability group 3w1; woody plant group 4.

Corunna Series

The Corunna series consists of nearly level, poorly drained soils on till plains. These soils formed in 20 to 40 inches of loamy material underlain by calcareous loamy glacial till.

In a representative profile the surface layer is very dark gray sandy loam 10 inches thick. The subsoil is sandy loam 28 inches thick. The upper 12 inches is grayish brown, friable, mottled sandy loam. The lower 16 inches is grayish brown, friable, mottled heavy sandy loam. The underlying material, at a depth of 38 inches, is calcareous, gray light clay loam.

Runoff is very slow to ponded. Permeability is moderate in the upper part of the profile and moderately slow in the lower part. Available water capacity is moderate.

If adequately drained, Corunna soils are well suited to farming. They are severely limited for most nonfarm uses.

Representative profile of Corunna sandy loam in a cultivated field 450 feet north and 2,520 feet west of the southeast corner of sec. 26, T. 8 N., R. 1 W.

Ap—0 to 10 inches; very dark gray (10YR 3/1) sandy loam; moderate medium granular structure; friable; few roots; neutral; abrupt smooth boundary.

B21g—10 to 22 inches; grayish brown (10YR 5/1) sandy loam; common coarse faint gray (10YR 5/1) mottles; weak medium subangular blocky structure; friable; neutral; gradual wavy boundary.

B22g—22 to 38 inches; grayish brown (10YR 5/2) heavy sandy loam; common medium faint yellowish brown (10YR 5/4) and few medium distinct brownish

yellow (10YR 6/6) mottles; moderate medium subangular blocky structure; friable; neutral; clear wavy boundary.

IICg—38 to 60 inches; gray (10YR 6/1) light clay loam; common coarse yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; friable; 3 percent pebbles; strong effervescence; moderately alkaline.

The solum is dominantly 30 to 40 inches thick, but ranges from 26 to 40 inches. Below the A horizon, it is slightly acid, neutral, or mildly alkaline.

The A horizon is very dark gray (10YR 3/1), black (10YR 2/1), or very dark grayish brown (10YR 3/2).

The B21g horizon is gray (10YR 5/1) or grayish brown (10YR 5/2). It is sandy loam, fine sandy loam, or loam. The B22g horizon and, where present, the B23g horizon are grayish brown (10YR 5/2) or gray (10YR 5/1) heavy sandy loam, sandy loam, or loamy fine sand.

The IICg horizon is gray (10YR 6/1) or dark gray (10YR 4/1, 2.5Y 4/0) loam, silt loam, clay loam, or silty clay loam.

Corunna soils in most landscapes are near Parkhill and Sims soils. They have a coarser textured solum than Parkhill and Sims soils.

Cr—Corunna sandy loam. This nearly level soil is on till plains. Individual areas range from 3 to 30 acres in size and are dominantly irregular in shape. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas where thin layers of sand and gravel are above the loam to clay loam underlying material. Also included are a few small areas of Metamora soils at slightly higher elevations, small areas of Parkhill soils, and intermittent ponds and small swampy areas, both of which are identified by spot symbols on the soil map.

Wetness is the main limitation of this soil for farming. If adequately drained, this soil is well suited to farming. Most areas are farmed. Crops commonly grown are corn, beans, wheat, and some forage. Undrained areas are used for native pasture or remain wooded with poor-quality lowland hardwoods. Limitations are severe for most nonfarm uses. Capability unit IIw–4(3/2c); woodland suitability group 3w2; woody plant group 4.

Edwards Series

The Edwards series consists of nearly level, very poorly drained soils on broad, low, wet plains and basins in small concave depressions in uplands; and in a few seepy spots on hillsides. These soils formed in organic material underlain by marl at a depth of 16 to 50 inches.

In a representative profile the surface layer is black muck 10 inches thick. The next layer is very dark brown, firm muck 14 inches thick. Below this is very dark grayish brown, friable sedimentary peat 2 inches thick. The upper part of the underlying material is light brownish gray, mottled marl 6 inches thick. The lower part, at a depth of 32 inches, is grayish brown, mottled marl.

Runoff is very slow to ponded. Permeability is moderately slow to moderately rapid in the organic material and varies in the marl. Available water capacity is very high.

Edwards soils are moderately well suited to specialty crops if wetness and the hazards of frost and soil blowing can be overcome or controlled. These soils are severely limited for most nonfarm uses.

Representative profile of Edwards muck in a cultivated area 900 feet west and 1,490 feet north of the southeast corner of sec. 24, T. 6 N., R. 4 W.

Oa1—0 to 10 inches; black (10YR 2/1 broken face and rubbed) sapric material; less than 5 percent fiber unrubbed and rubbed; weak medium granular structure; friable; mildly alkaline; slight effervescence; abrupt smooth boundary.

Oa2—10 to 24 inches; very dark brown (10YR 2/2 broken face and rubbed) sapric material; less than 5 percent fiber unrubbed and rubbed; moderate thick platy structure; firm; herbaceous and sedimentary material; slightly acid; abrupt wavy boundary.

IILco1—24 to 26 inches; very dark grayish brown (10YR 3/2) broken face, dark grayish brown (10YR 4/2) rubbed coprogenous earth; no fiber content; massive; friable; loose shells of 10YR 7/1 imbedded in peat; strong effervescence; moderately alkaline; clear wavy boundary.

IIILca1—26 to 32 inches; light brownish gray (10YR 6/2) marl; many fine distinct light olive brown (2.5Y 5/6) mottles; massive; friable; violent effervescence; moderately alkaline; clear smooth boundary.

IIILca2—32 to 60 inches; grayish brown (10YR 5/2) marl; many medium distinct light olive brown (2.5Y 5/6) mottles; massive; friable; violent effervescence; moderately alkaline.

Organic material is dominantly between 18 and 36 inches thick, but ranges from 16 to 50 inches. It is dominantly herbaceous in origin. Thin layers of hemic material occur in some profiles. Reaction of the organic material ranges from slightly acid to calcareous. Snail shells throughout the organic material are not uncommon in places where the organic material is less than 20 inches deep.

Color in the Oa1 and Oa2 horizons is black (10YR 2/1, N 2/0) or very dark brown (10YR 2/2). The marl is light brownish gray (10YR 6/2), grayish brown (10YR 5/2), or light gray (10YR 7/1, 7/2). It contains a considerable amount of silt in places.

Edwards soils are similar to Adrian, Houghton, and Palms soils. They are organic to a depth of less than 50 inches and are underlain by marl, whereas Houghton soils are organic to a depth of more than 50 inches, Adrian soils have sandy material within a depth of 50 inches, and Palms soils have loamy material within a depth of 50 inches.

Ed—Edwards muck. This nearly level soil is on broad, low wet plains; in basins; in small concave depressions in uplands; and in a few seepy spots on hillsides. Individual areas range from approximately 3 acres in size in seepy spots to 30 acres in size in basins and on plains. Most areas are irregular in shape.

Included with this soil in mapping are areas of soils where the organic material is less than 16 inches deep over marl and a few places where plowing has mixed the marl into the plow layer. Also included are small areas where the underlying marl is only 6 to 12 inches deep and is underlain by loamy or sandy material, and other inclusions where the layer or sedimentary peat, which is just above the marl, is thicker.

Wetness, frost hazard, soil blowing, poor stability of the organic material, and marl are the main limitations. Some areas have been cleared, drained, and farmed. Others are idle or in pasture. If well managed, this soil is moderately well suited to such specialty crops as vegetables and grass sod. Small upland depressions are used for corn and soybeans. Some areas are wooded with slow growing, poor-quality lowland hardwoods and conifers. A few areas have been mined for liming material. Limitations are severe for nonfarm uses. Capability unit IVw–2(M/mc); woodland suitability group 4w2; woody plant group 1.

Gilford Series

The Gilford series consists of nearly level, very poorly drained soils on wet, sandy and loamy outwash plains, lake plains, and old glacial drainageways.

In a representative profile the surface layer is black sandy loam 10 inches thick. The subsoil is 18 inches thick. The upper 14 inches is gray, friable, mottled sandy loam. The lower 4 inches is very friable, mottled sandy loam. The upper 6 inches of the underlying material is light brownish gray mottled sand. Below this is calcareous, gray, stratified sand and gravel.

Runoff is very slow to ponded. Permeability is moderately rapid. Available water capacity is low.

If well managed and drained, Gilford soils are suited to such crops as corn, beans, small grain, and forage. These soils are severely limited for most nonfarm uses.

Representative profile of Gilford sandy loam in a cultivated area 1,840 feet south and 450 feet west of the northeast corner of sec. 32, T. 7 N., R. 3 W.

Ap—0 to 10 inches; black (10YR 2/1) sandy loam; weak medium granular structure; very friable; 5 percent pebbles; neutral; abrupt smooth boundary.

B21g—10 to 24 inches; gray (10YR 5/1) sandy loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; tongues and streaks of black (10YR 2/1) extend along root channels and cracks; 5 percent pebbles; neutral; gradual wavy boundary.

B22g—24 to 28 inches; gray (10YR 6/1) sandy loam; common medium distinct yellowish brown (10YR 5/6) and few medium faint dark gray (10YR 4/1) mottles; moderate medium subangular blocky structure; very friable; 5 percent pebbles; neutral; clear wavy boundary.

IIC1g—28 to 34 inches; light brownish gray (10YR 6/2) sand; few coarse distinct strong brown (7.5YR 5/6) mottles; single grained; loose; neutral; clear wavy boundary.

IIC2g—34 to 60 inches; gray (10YR 5/1) stratified sand and gravel; single grained; loose; 50 percent pebbles; moderately alkaline; strong effervescence.

The solum is dominantly 24 to 36 inches thick, but ranges from 26 to 44 inches. Pebble content ranges from 1 to 6 percent. Below the surface layer, the solum ranges from medium acid to neutral.

A black (10YR 2/1) or very dark gray (10YR 3/1) A1 horizon occurs in undisturbed areas. An A12 horizon is present in places. The A horizon is commonly sandy loam, but in places it is loam, fine sandy loam, and loamy sand.

In the Bg horizon chroma is 2 or less, value is 4, 5, and 6, and hue is 10YR or 2.5Y. This horizon contains some thin layers of loamy sand and not more than 10 inches of material as heavy as sandy clay loam or light clay loam.

The IIC horizon ranges from coarse sand and gravel to sand. Thin layers of sandy loam, silt, and silt loam occur in some profiles.

Gilford soils in most landscapes are near Granby, Colwood, Sebewa, and Wasepi soils. They have a finer textured subsoil than Granby soils and a coarser textured subsoil than Colwood soils. They are underlain by sand and gravel, whereas Colwood soils are underlain by fine sand and silt. These soils have a coarser textured solum than Sebewa soils. They have a gray subsoil, whereas Wasepi soils have a yellowish brown subsoil.

Gf—Gilford sandy loam. This nearly level soil is on low, wet outwash plains, lake plains, and old glacial drainageways. Individual areas range from 20 to 80 acres in size. This soil also occurs, to a limited extent, in wet upland pockets and along small streams. In these places individual areas range from 2 to 15 acres in size. They are long and narrow. Slopes are 0 to 2 percent.

Included with this soil in mapping are areas of soils that have a surface layer of thin black muck and a subsoil of loamy sand. Also included are a few small areas of Sebewa soils that occur in no regular pattern and small slightly higher spots of Wasepi soils.

Wetness is the main limitation of this soil for farming. Many areas are drained and farmed. Other undrained areas are in native pasture or are wooded with poor-quality lowland hardwoods. A few areas are used as a source of gravel. If adequately drained and well managed, this soil is suited to corn, beans, small grains, and forage crops. A few areas are used for such special crops as cucumbers, melons, tomatoes, and other vegetables. Limitations are severe for most nonfarm uses. Capability unit IIIw–1(4c); woodland suitability group 3w1; woody plant group 4.

Granby Series

The Granby series consists of nearly level, very poorly drained and poorly drained soils on wet sandy plains, in morainic depressions, and in drainageways.

In a representative profile the surface layer is black and very dark grayish brown loamy sand 14 inches thick. The subsoil is 12 inches thick. The upper 8 inches is light brownish gray, single grained, mottled sand. The lower 4 inches is grayish brown, very friable, mottled loamy sand. The underlying material, at a depth of 26 inches, is light brownish gray, mottled sand.

Runoff is very slow to ponded. Permeability is rapid. Available water capacity is low.

If adequately drained and well managed, Granby soils are moderately well suited to farming. These soils are severely limited for most nonfarm uses.

Representative profile of Granby loamy sand in a cultivated area 1,000 feet east and 1,490 feet north of the southwest corner of sec. 29, T. 5 N., R. 1 W.

Ap—0 to 12 inches; black (10YR 2/1) loamy sand; weak fine granular structure; very friable; neutral; abrupt smooth boundary.

A12—12 to 14 inches; very dark grayish brown (2.5Y 3/2) loamy sand; weak fine subangular blocky structure; friable; grading to loose; neutral; abrupt wavy boundary.

B1g—14 to 22 inches; light brownish gray (10YR 6/2) sand; common coarse distinct yellow (10YR 7/6) mottles; single grained; neutral; abrupt wavy boundary.

B2g—22 to 26 inches; grayish brown (10YR 5/2) loamy sand; common, medium distinct yellowish brown (10YR 5/6) and common coarse distinct light olive gray (5Y 6/2) mottles; weak coarse subangular blocky structure; very friable; neutral; clear wavy boundary.

Cg—26 to 60 inches; light brownish gray (2.5Y 6/2) sand; common coarse faint light yellowish brown (2.5Y 6/4) and few medium faint light olive brown (2.5Y 5/6) mottles; single grained; loose; 3 percent pebbles; moderately alkaline.

Reaction in the upper 26 inches of the profile ranges from slightly acid to neutral. Color of the Ap horizon ranges from black (10YR 2/1), very dark gray (10YR 3/1), and very dark brown (10YR 2/2) to very dark grayish brown (10YR 3/2). The Ap horizon is typically loamy sand or sand. Color in the A12 horizon is very dark grayish brown (2.5Y 3/2, 10YR 3/2), very dark gray (10YR 3/1), or very dark brown (10YR 2/2). The A12 horizon is typically loamy sand or sand. The A1 horizon ranges from 11 to 14 inches in thickness. A gray (10YR 6/1) or light brownish gray (10YR 6/2) A2g horizon is below the A1 horizon in places.

In the B horizon hue is 10YR and 2.5Y, value is 4, 5,

and 6, and chroma is 1 and 2. Thin lenses of sandy loam ¼ to ½ inch thick are in the lower part of the B horizon in places.

In the C horizon hue is 2.5Y and 10YR, value is 5 and 6, and chroma is 1 and 2. The C horizon is sand, but thin discontinuous layers of very fine sand, silt and loam occur below a depth of 30 inches in places. Granby soils in most landscapes are near Gilford soils. They have a coarser textured subsoil than Gilford soils.

Gr—Granby loamy sand. This nearly level soil is on plains, in depressions and drainageways, and at narrow outer margins and slightly elevated areas within larger areas of organic soils. Individual areas range from 2 to 40 acres in size. The areas of soils on the plains range from 20 to 40 acres in size and are irregular in shape. Those areas at the outer margin of muck areas are 2 to 10 acres in size. They are long and narrow. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of soils where the surface layer is thinner because of soil blowing. Also included are a few small areas of Adrian muck.

Wetness and soil blowing are the main limitations. This soil has a fluctuating high water table that is at or near the surface during wet periods and drops below a depth of 3 feet during dry periods. When it is dry and exposed, this sandy soil is easily blown by wind.

If drained and well managed, this soil is moderately suited to farming. Some areas have been cleared, drained, and farmed. Others are used for specialty crops, but require irrigation as well as drainage. Others are idle or used for pasture. A few areas are wooded with poor-quality, slow growing lowland hardwoods. Limitations are severe for most nonfarm uses. Capability unit IIIw–1(5c); woodland suitability group 5w1; woody plant group 4.

Houghton Series

The Houghton series consists of nearly level, very poorly drained soils on low, wet plains and in basins and small concave depressions of the uplands. These soils formed in deep organic material. They are muck to a depth of 60 inches or more.

In a representative profile the surface layer is black, is well decomposed, and is 9 inches thick. The next 4 inches is black, the next 11 inches dark reddish brown, the next 8 inches black, and the lower 34 inches dark reddish brown.

Runoff is very slow to ponded. Permeability is moderately slow to moderately rapid. Available water capacity is very high.

Houghton soils are well suited to specialty crops if wetness and the hazards of frost and soil blowing can be overcome. These soils are severely limited for most nonfarm uses.

Representative profile of Houghton muck, 900 feet west of the southeast corner of sec. 11, T. 5 N., R. 1 W.

Oa1—0 to 9 inches; black (7.5YR 2/0 broken face and rubbed) sapric material; about 5 percent fiber, a trace rubbed; weak coarse subangular blocky structure; neutral; abrupt smooth boundary.

Oa2—9 to 13 inches; black (7.5YR 2/0 broken face), very dark brown (7.5YR 2/2 rubbed) sapric material; about 5 percent fiber, a trace rubbed; weak medium granular structure; neutral; abrupt smooth boundary.

Oa3—13 to 24 inches; dark reddish brown (5YR 3/2, broken face), dark reddish brown (5YR 2/2 rubbed) sapric material; about 15 percent fiber, less than 5 percent rubbed; massive breaking to thick platy fragments; neutral; abrupt smooth boundary.

Oa4—24 to 32 inches; black (5YR 2/1 broken face and rubbed) sapric material; about 10 percent fiber, a trace rubbed; massive; a few woody fragments; neutral; clear wavy boundary.

Oa5—32 to 48 inches; dark reddish brown (5YR 2/2 broken face), black (5YR 2/1 rubbed) sapric material; about 20 percent fiber, less than 10 percent rubbed; massive, breaking to thick platy fragments; neutral; abrupt smooth boundary.

Oa6—48 to 60 inches; dark reddish brown (5YR 2/2 broken face and rubbed) sapric material; about 10 percent fiber, less than 10 percent rubbed; massive, slightly sticky; about 15 percent mineral soil; neutral.

Organic material ranges from 51 inches to 20 feet or more in thickness and is primarily herbaceous. Some soils contain varying amounts of woody material below the Oa1 layer. The control section is dominated by sapric material, but in places hemic layers less than 10 inches thick occur below the Oa1 layer. Reaction ranges from medium acid to mildly alkaline.

Individual layers in sequence downward through the Oa6 layer are black (10YR 2/0, 7.5YR 2/0, 5YR 2/1), dark reddish brown (5YR 3/2, 5YR 2/2), or dark brown (7.5YR 3/2). Colors become darker after the soil material is exposed to the air.

Houghton soils are similar to Adrian, Edwards, and Palms soils. They are organic to a depth of more than 50 inches, whereas Adrian soils are underlain by sandy material within a depth of 50 inches, Edwards soil by marl, and Palms soils by loamy material.

Ho—Houghton muck. This nearly level soil is on broad, low plains and in basins and small concave depressions of the uplands. Individual areas range from less than 10 acres in size in the upland depressions to several hundred acres in size on the low plains and in the basins. They are irregular in shape. Slopes are 0 to 2 percent.

Included with this soil in mapping are areas of soils that have more woody material in the upper part, areas of soils that are more acid, and a few small areas of water. Also included are small areas of Adrian and Palms soils and Edwards muck. Adrian and Palms soils are commonly at the outer margin of Houghton soil areas. The spots of Edwards muck occur in no regular pattern.

The wetness, the hazards of frost and soil blowing, and the poor stability of the organic material are major limitations. Many areas have been cleared, drained, and farmed. Others are idle or pastured.

If well managed, this soil is well suited to vegetable crops and other special crops, such as mint and grass sod. Small areas are used mainly for corn and soybeans. Some areas are wooded with poor-quality, slow-growing lowland hardwoods. Limitations are severe for most nonfarm uses. Capability unit IIIw–3(Mc); woodland suitability group 4w2; woody plant group 1.

Kibbie Series

The Kibbie series consists of nearly level and gently sloping, somewhat poorly drained soils along old glacial drainage channels and on lake plains. These soils formed in sandy and loamy material.

In a representative profile the surface layer is very dark grayish brown loam 4 inches thick. The subsurface layer is pale brown loam 6 inches thick. The upper

9 inches of the subsoil is yellowish brown, friable, mottled light silty clay loam. The lower 12 inches is brown, friable, mottled heavy silt loam. The underlying material, at a depth of 31 inches, is calcareous brown silt loam.

Runoff is slow. Permeability is moderate. Available water capacity is very high.

If adequately drained, Kibbie soils are well suited to farming. These soils are severely limited for most nonfarm uses.

Representative profile of Kibbie loam, 0 to 3 percent slopes, in a wooded area 1,200 feet south and 900 feet west of the northeast corner of sec. 29, T. 7 N., R. 3 W.

A1—0 to 4 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; neutral; abrupt irregular boundary.

A2—4 to 10 inches; pale brown (10YR 6/3) loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium granular structure; friable; medium acid; clear wavy boundary.

B21t—10 to 19 inches; yellowish brown (10YR 5/4) light silty clay loam; common medium faint yellowish brown (10YR 5/8) and few fine faint grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; thin discontinuous clay films on surfaces of some peds; medium acid; gradual wavy boundary.

B22t—19 to 31 inches; brown (10YR 5/3) heavy silt loam; common fine faint grayish brown (10YR 5/2) and few medium faint yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; friable; very few thin discontinuous clay films on surfaces of some peds; neutral; clear wavy boundary.

C—31 to 60 inches; brown (10YR 5/3) silt loam; common medium distinct olive yellow (2.5Y 6/6) and common medium faint grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; friable; horizon contains thin (¼ to 3 inches thick) discontinuous strata of silt and very fine sand; strong effervescence; moderately alkaline.

The solum is dominantly 24 to 32 inches thick, but ranges from 24 to 40 inches. The A1 horizon is very dark grayish brown (10YR 3/2) or black (10YR 2/1) loam or fine sandy loam. In cultivated areas The Ap horizon is very dark grayish brown (10YR 3/2), very dark brown (10YR 2/2), or very dark gray (10YR 3/1) loam or fine sandy loam. The A2 horizon is pale brown (10YR 6/3) or brown (10YR 5/3).

The B2 horizon is yellowish brown (10YR 5/4), brown (10YR 5/3), or dark yellowish brown (10YR 4/4). It is light silty clay loam, loam, or silt loam that has thin strata of fine sand, loamy sand, and sandy loam.

The C horizon is silt loam or silt that has thin strata of sand, loamy sand, silty clay loam, or silty clay. It has strong or violent effervescence.

Kibbie soils in most landscapes are near Sisson, Colwood, and Capac soils. They have grayish brown mottles in the upper part of the subsoil, which Sisson soils lack. They have a brown subsoil, whereas Colwood soils have a gray subsoil. An underlying layer of stratified silt and fine sand distinguishes Kibbie soils from Capac soils.

KbA—Kibbie loam, 0 to 3 percent slopes. This nearly level and gently sloping soil is on foot slopes and at the heads of drainageways near old glacial drainage channels. It also occurs as minor areas in no regular pattern on the lake plain. Individual areas range from 5 to about 15 acres in size. They are irregular in shape.

Included with this soil in mapping are areas of soils that have a coarser textured subsoil. Also included are Colwood soils in small narrow drainageways.

Wetness is the main limitation of this soil for farming. This soil is well suited to this use if adequately drained. Most areas are now farmed, and such crops as corn, field beans, soybeans, wheat, oats, and forage are grown. A few small areas are wooded with second-growth mixed hardwoods. Limitations are severe for most nonfarm uses. Capability unit IIw–3(2.5b–s); woodland suitability group 2o4; woody plant group 2.

Lapeer Series

The Lapeer series consists of gently sloping, well drained soils on till plains and moraines. These soils formed in loamy glacial material.

In a representative profile the surface layer is dark grayish brown sandy loam 7 inches thick. The upper 5 inches of the subsoil is yellowish brown, friable sandy loam. The middle 13 inches is yellowish brown, friable sandy loam 13 inches thick. The lower 9 inches of the subsoil is dark yellowish brown, firm, heavy sandy loam.

Runoff is slow to medium. Permeability is moderate. Available water capacity is moderate.

Lapeer soils are well suited to farming. They are slightly limited for many nonfarm uses.

Representative profile of Lapeer sandy loam, 2 to 6 percent slopes, in a cultivated area approximately 2,140 feet west and 1,300 feet south of the northeast corner of sec. 25, T. 5 N., R. 1 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) sandy loam; weak medium granular structure; friable; many fine roots; 3 percent pebbles; medium acid; abrupt wavy boundary.

B1—7 to 12 inches; yellowish brown (10YR 5/6) sandy loam; weak medium platy structure; friable; 3 percent pebbles; medium acid; clear wavy boundary.

B21t—12 to 25 inches; yellowish brown (10YR 5/6) sandy loam; weak medium subangular blocky structure; friable; few thin discontinuous clay films of dark brown (10YR 4/3) on surfaces of peds; 3 percent pebbles; medium acid; gradual wavy boundary.

B22t—25 to 34 inches; dark yellowish brown (10YR 4/4) heavy sandy loam; moderate medium subangular blocky structure; firm thin discontinuous clay films of dark brown on surfaces of peds; 5 percent pebbles; slightly acid; clear wavy boundary.

C—34 to 60 inches; brown (10YR 5/3) sandy loam; weak coarse subangular blocky structure; friable; 12 percent pebbles; slight effervescence; mildly alkaline.

The solum ranges from 24 to 36 inches thick, and coincides with the depth to carbonates. Pebble content ranges from 1 to 10 percent in the solum and from 5 to 15 percent in the C horizon.

The Ap horizon is dark grayish brown (10YR 4/2) or dark brown (10YR 4/3) sandy loam or loam. Where present, the A2 horizon is brown (10YR 5/3) or pale brown (10YR 6/3) sandy loam or loamy sand.

The B1 horizon is not present in all profiles. The B1 horizon is yellowish brown (10YR 5/4, 5/6) or dark yellowish brown (10YR 4/4) heavy sandy loam, light sandy clay loam, or light loam. The Bt horizon averages less than 18 percent clay.

The C horizon is brown (10YR 5/3) or light yellowish brown (10YR 6/4) sandy loam that has pockets of loamy sand or sand. Reaction ranges from mildly alkaline to moderately alkaline.

Lapeer soils in most landscapes are near Boyer, Oshtemo, Marlette, and Sisson soils. These soils have a finer textured substratum than Boyer soils and a coarser textured subsoil than Marlette soils. They have a thinner solum and lack the underlying sand and gravel that are characteristic of Oshtemo soils. They have a coarser textured subsoil and underlying material than Sisson soils.

LaB—Lapeer sandy loam, 2 to 6 percent slopes. This gently sloping soil is on till plains. Slopes are dominantly 2 or 5 percent and are less than 250 feet in length. Individual areas range from 3 to approximately 20 acres in size. They are irregular in shape.

Included with this soil in mapping are areas of soils that have a finer textured subsoil and small eroded areas that have a surface layer of yellowish brown sandy loam.

Insufficient moisture for plant growth during prolonged dry periods and an erosion hazard are the major limitations. Most areas are farmed, and this soil is well suited to such crops as corn, beans, wheat, oats, and forage. A few small areas are wooded with mixed hardwoods. Limitations are few for many nonfarm uses. Capability unit IIe–3 (3a); woodland suitability group 2o2; woody plant group 3.

Marlette Series

The Marlette series consists of gently sloping to steep, well drained and moderately well drained soils on broad till plains and on moraines. These soils formed in calcareous loamy glacial till.

In a representative profile the surface layer is very dark grayish brown loam 5 inches thick. The subsurface layer is pale brown loam 9 inches thick. The upper 6 inches of the subsoil is a mixture of yellowish brown, firm, light clay loam and pale brown friable loam. The next 8 inches is brown, firm clay loam. The lower 10 inches of the subsoil is brown, very firm clay loam. The underlying material, at a depth of 38 inches, is calcareous pale brown light clay loam.

Runoff is moderate to rapid. Permeability is moderate and moderately slow. Available water capacity is high.

Marlette soils are well suited to farming. Restricted permeability in the subsoil moderately limits these soils for many nonfarm uses.

Representative profile of Marlette loam, 2 to 6 percent slopes, in a wooded area, 2,440 feet north and 260 feet east of the southwest corner of sec. 10, T. 8 N., R. 3 W.

A1—0 to 5 inches; very dark grayish brown (10YR 3/2) loam; weak fine granular structure; friable; many fine roots; 3 percent pebbles; medium acid; abrupt irregular boundary.

A21—5 to 9 inches; pale brown (10YR 6/3) loam; weak medium platy structure; friable; streaks (worm casts) of very dark grayish brown (10YR 3/2); 3 percent pebbles; medium acid; gradual wavy boundary.

A22—9 to 14 inches; pale brown (10YR 6/3) loam; moderate medium platy structure; friable; consistence grading to slightly brittle; 3 percent pebbles; medium acid; clear irregular boundary.

B&A—14 to 20 inches; yellowish brown (10YR 5/4) light clay loam (B part) and pale brown (10YR 6/3) loam (A part) as coatings on surfaces of peds; moderate medium subangular blocky structure; firm (B part); friable (A part); A material constitutes more than 15 percent of horizon; 5 percent pebbles; medium acid; clear irregular boundary.

B21t—20 to 28 inches; brown (10YR 5/3) clay loam; moderate medium subangular blocky structure; firm; thin discontinuous traces of bleaching on surfaces of peds; 5 percent pebbles; medium acid; clear wavy boundary.

B22t—28 to 38 inches; brown (10YR 5/3) clay loam; strong medium subangular blocky structure; very firm; clay flows and continuous clay films of dark brown (10YR 4/3); 5 percent pebbles; slightly acid; clear wavy boundary.

C—38 to 60 inches; pale brown (10YR 6/3) light clay loam; few fine faint gray (10YR 6/1) lime streaks; weak medium subangular blocky structure; firm; strong effervescence; moderately alkaline.

The solum is dominantly 30 to 40 inches thick, but ranges from 24 to 44 inches. It coincides with depth to effervescent material. Pebble content throughout the solum and the C horizon ranges from 1 to 10 percent. Reaction below the Ap horizon ranges from medium acid to neutral.

The A1 horizon is very dark grayish brown (10YR 3/2) or very dark gray (10YR 3/1) loam or sandy loam. In cultivated areas, the Ap horizon is dark grayish brown (10YR 4/2), very dark grayish brown (10YR 3/2), or yellowish brown (10YR 5/4) loam or sandy loam. Where present, the A2 horizon is pale brown (10YR 6/3) or brown (10YR 5/3) loam or sandy loam. The B&A horizon represents an intermixing of the A2 and Bt horizons. It has colors and textures of both horizons.

The B2t horizon is brown (10YR 5/3), yellowish brown (10YR 5/4, 5/6), dark yellowish brown (10YR 4/4), or dark brown (10YR 4/3) clay loam, silty clay loam, or heavy loam.

The C horizon is pale brown (10YR 6/3), brown (10YR 5/3), or yellowish brown (10YR 5/4) loam or light clay loam glacial till.

Marlette soils in most landscapes are near Capac, Owosso, Lapeer, and Morley soils. They do not have the mottled subsoil characteristic of Capac soils. They have a finer textured upper part of the subsoil than Owosso and Lapeer soils. They are coarser textured in the subsoil and underlying material than Morley soils.

MaB—Marlette loam, 2 to 6 percent slopes. This gently sloping soil is on broad till plains and moraines. Individual areas range from 3 to more than 100 acres in size, but most areas are from 15 to approximately 50 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of soils that lack the intermingling of pale brown and yellowish brown colors in the upper part of the subsoil and many small areas of soils on ridges and knolls that are eroded and have a surface layer of light clay loam. Also included are areas of soils, especially along major drainageways, that have a subsoil of gravelly clay loam. Included in local closed depressions are Parkhill and Washtenaw soils. Inclusions of small wet areas and sandy areas less than 3 acres in size are identified by spot symbols on the soil map.

Erosion is the main hazard. This soil is well suited to farming, and most areas are in such crops as corn, field beans, soybeans, wheat, oats, and forage. Some areas are wooded with mixed hardwoods. Limitations are moderate for some nonfarm uses. Capability unit IIe–2 (2.5a); woodland suitability group 2o1; woody plant group 3.

MaC—Marlette loam, 6 to 12 percent slopes. This sloping soil is on moraines and short sloping hillsides of broad till plains. Individual areas range from 3 to 25 acres in size. Slopes are dominantly less than 200 feet long. This soil has a profile similar to the one described as representative of the series, but the surface layer, subsurface layer, and subsoil are thinner.

Included with this soil in mapping are small eroded areas at the crest of slopes and on knolls where the surface layer is yellowish brown loam or clay loam. Also included on the sloping sides of major drainageways are soils where the subsoil is gravelly clay loam. Also included are small areas of Owosso and Morley

soils and small areas of Parkhill and Washtenaw soils in wet depressions.

Erosion is the main hazard. Most areas are cleared and farmed. Corn, field beans, soybeans, wheat, oats, and forage crops are grown. If well managed, this soil is well suited to farming. Some areas are wooded with mixed hardwoods. Limitations are moderate for most nonfarm uses. Capability unit IIIe–2(2.5a); woodland suitability group 2o1; woody plant group 3.

MaD—Marlette loam, 12 to 18 percent slopes. This moderately steep soil is on narrow ridges and on short side slopes leading to drainageways, swales, and closed depressions. Slopes are dominantly 100 to 200 feet in length, and they are complex. Individual areas average 5 to 15 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer, subsurface layer, and subsoil are thinner.

Included with this soil in mapping are small eroded areas at the crest of slopes and on knolls where the surface layer is yellowish brown loam or clay loam. Also included are Parkhill and Washtenaw soils in small depressions.

Limitations are severe for most uses because of slope and the erosion hazard. Most areas have been cleared and farmed. Small grains and forage are the main crops, but row crops are also grown. Some farm areas are in grass, weeds, and brush and are now idle. A few areas are wooded with mixed hardwoods. Limitations are severe for most nonfarm uses. Capability unit IVe–1 (2.5a); woodland suitability group 2o1; woody plant group 3.

MaE—Marlette loam, 18 to 25 percent slopes. This steep soil is on short side slopes leading to deeply cut drainageways, swales, and other depressed areas. Slopes are less than 200 feet in length. Individual areas are dominantly less than 10 acres in size, and are long and narrow. This soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil are thinner. Included in mapping are small areas where slopes are more than 25 percent, and eroded areas where the surface layer is clay loam.

This soil is not suited to farming. Most areas are wooded. The remaining areas are pastured. Limitations are severe for most uses. Capability unit VIe–1 (2.5a); woodland suitability group 2r1; woody plant group 3.

MbC3—Marlette clay loam, 6 to 12 percent slopes, severely eroded. This sloping soil is on eroded hillsides of till plains and moraines. Slopes are short. Areas range from 3 to about 30 acres in size and are elongated. This soil differs from the one described as representative of the series as a result of severe erosion. The surface layer is brown or yellowish brown clay loam. It has little organic matter content, is sticky when wet, and is hard and crusted when dry. Included in mapping are small areas that are less eroded and small areas where the surface layer is gravelly clay loam.

Controlling erosion and slope are the main problems. All areas of this soil have been farmed. Because of erosion, this soil is not well suited to cultivated crops. Some areas are idle or are pastured. Others are used for such row crops as corn, field beans, and soybeans. Limitations are moderate for most nonfarm uses. Capability unit IVe–2(2.5a); woodland suitability group 2o1; woody plant group 3.

MbD3—Marlette clay loam, 12 to 18 percent slopes, severely eroded. This moderately steep soil is on narrow ridges and short side slopes leading to drainageways, swales, and closed depressions. Slopes are dominantly 100 to 200 feet long, and they are complex. Individual areas are small. This soil differs from the one described as representative of the series as a result of severe erosion. The surface layer is brown or yellowish brown clay loam. It has little organic matter content, is sticky when wet, and is hard and crusted when dry. Included in mapping are small areas that are less eroded and small areas where the surface layer is gravelly clay loam.

A severe erosion hazard and slope are the main limitations. All areas of this soil have been farmed. This soil is poorly suited to cultivated crops. Some areas are idle or are pastured. Others are used for such row crops as corn, field beans, and soybeans. This soil is well suited to forage crops, pasture, or woodland. Limitations are severe for most nonfarm uses. Capability unit VIe–2(2.5a); woodland suitability group 2o1; woody plant group 3.

Matherton Series

The Matherton series consists of nearly level to gently sloping, somewhat poorly drained soils that formed in loamy outwash material.

In a representative profile the surface layer is very dark brown loam 8 inches thick. The subsurface layer is light brownish gray mottled sandy loam 5 inches thick. The upper 5 inches of the subsoil is grayish brown, firm, mottled sandy clay loam. The middle 10 inches is very firm, mottled clay loam. The lower 4 inches of the subsoil is dark yellowish brown, very firm, mottled clay loam. The underlying material at a depth of 32 inches is calcareous, mottled pale brown coarse sand and gravel.

Runoff is slow. Permeability is moderate in the subsoil and rapid in the sand and gravel underlying material. Available water capacity is moderate.

If adequately drained, Matherton soils are well suited to farming. These soils are severely limited for many nonfarm uses.

Representative profile of Matherton loam, 0 to 3 percent slopes, in a cultivated area, 200 feet north and 2,090 feet east of the southwest corner of sec. 11, T. 7 N., R. 1 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam; weak fine granular structure; friable; few roots; 5 percent pebbles, slightly acid; abrupt smooth boundary.

A2—8 to 13 inches; light brownish gray (10YR 6/2) sandy loam; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine granular structure; friable; few very dark brown (10YR 2/2) worm casts; 5 percent pebbles, slightly acid; clear wavy boundary.

B21tg—13 to 18 inches; grayish brown (10YR 5/2) sandy clay loam; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; firm; few very dark brown worm casts; 5 percent pebbles; neutral; clear wavy boundary.

B22tg—18 to 28 inches; grayish brown (10YR 5/2) clay loam; common fine distinct yellowish brown (10YR 5/8) mottles; weak medium subangular blocky

structure; very firm; 5 percent pebbles; neutral; clear wavy boundary.

B23tg—28 to 32 inches; dark yellowish brown (10YR 3/4) clay loam; common fine distinct grayish brown (10YR 5/2) and strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; very firm; thin continuous coatings of grayish brown (10YR 5/2) on surfaces of peds; 10 percent pebbles; neutral; clear wavy boundary.

IIC—32 to 60 inches; pale brown (10YR 6/3) stratified coarse sand and gravel; few fine distinct yellowish brown (10YR 5/8) mottles; single grained; loose; 5 percent pebbles; strong effervescence; moderately alkaline.

The solum is 24 to 40 inches thick. Pebble content in the solum ranges from 2 to 15 percent. Reaction below the Ap horizon ranges from medium acid to neutral.

The Ap horizon is very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), or very dark gray (10YR 3/1). The A1 horizon where present, is very dark gray (10YR 3/1) or black (10YR 2/1) loam 2 to 4 inches thick. The A2 horizon is light brownish gray (10YR 5/2) to grayish brown (10YR 5/2) loam or sandy loam.

The B21t horizon is grayish brown (10YR 5/2), brown (10YR 5/3), or dark grayish brown (10YR 4/2) sandy clay loam, heavy loam, or gravelly clay loam. The B22tg horizon is grayish brown (10YR 5/2 or 2.5Y 5/2) or light brownish gray (10YR 6/2), clay loam gravelly clay loam, or sandy clay loam. The matrix color of peds is brighter colored in places, but there the surface of peds consistently have low chroma. Tongues of the B2t horizon are 2 to 12 inches thick and are as much as 24 inches long. They extend into the IIC horizon in places.

The IIC horizon is pale brown (10YR 6/3), light gray (10YR 7/1), gray (10YR 6/1), light brownish gray (10YR 6/2) grayish brown (10YR 5/2) or light yellowish brown (10YR 6/4) stratified sand and gravel or dominantly coarse sand. Pebble content ranges from 5 to 55 percent. This horizon has strong to violent effervescence.

Matherton soils in most landscapes are near Sebewa and Wasepi soils. They have a grayish brown subsoil, whereas Sebewa soils have a gray subsoil. Matherton soils have a finer textured subsoil than Wasepi soils.

MdA—Matherton loam, 0 to 3 percent slopes. This nearly level and gently sloping soil is in outwash areas, on terraces and foot slopes in tributary drains, and in drainage heads associated with major drainage channels. Individual areas are dominantly 10 to 25 acres in size, but a few areas on broad stream terraces range up to 80 acres or more in size.

Included in mapping are small areas where depth to the stratified coarse sand and gravel is more than 40 inches.

Wetness is a major limitation in farming. Installing drainage may be a problem because of the loose nature of the underlying material. If adequately drained, this soil is well suited to corn, beans, wheat, and forage crops. Many areas are farmed. Some are used entirely for forage crops and pasture. Limitations are severe for most nonfarm uses. A few areas have been developed as a source of sand and gravel. Capability unit IIw–3(3/5b); woodland suitability group 2o4; woody plant group 2.

Metamora Series

The Metamora series consists of nearly level and gently sloping, somewhat poorly drained soils on till plains, moraines, and on transition areas between loamy till plains, sandy lake plains, and outwash plains.

In a representative profile the surface layer is very dark grayish brown sandy loam 8 inches thick. The subsurface layer is light brownish gray loamy sand 6 inches thick. The upper 11 inches of the subsoil is brown, very friable, mottled light sandy loam. The middle 7 inches is dark yellowish brown, firm, mottled heavy sandy loam. The lower 8 inches of the subsoil is light brownish gray, firm, mottled light clay loam. The underlying material at a depth of 40 inches is calcareous brown loam.

Runoff is slow. Permeability is moderately rapid in the upper part of the profile and moderately slow in the underlying material. Available water capacity is high.

If adequately drained, Metamora soils are well suited to farming. They are severely limited for many nonfarm uses.

Representative profile of Metamora sandy loam, in an area of Metamora-Capac sandy loams, 0 to 4 percent slopes, in a cultivated area, 1,000 feet east and 2,140 feet south of the northwest corner of sec. 33, T. 7 N., R. 2 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) sandy loam; weak fine granular structure; friable; common roots; 3 percent pebbles; strongly acid; abrupt smooth boundary.

A2—8 to 14 inches; light brownish gray (10YR 6/2) loamy sand; weak fine subangular blocky structure; friable; common roots; 3 percent pebbles; medium acid; clear wavy boundary.

B1—14 to 25 inches; brown (10YR 5/3) light sandy loam; many fine faint grayish brown (10YR 5/2) and common fine distinct yellowish red (5YR 4/6) mottles; weak fine subangular blocky structure; very friable; 3 percent pebbles; slightly acid; gradual wavy boundary.

B21t—25 to 32 inches; dark yellowish brown (10YR 4/4) heavy sandy loam; common fine distinct light gray (10YR 7/2) and yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; 5 percent pebbles; neutral; clear wavy boundary.

IIB22tg—32 to 40 inches; light brownish gray (10YR 6/2) light clay loam; common fine distinct reddish yellow (7.5YR 6/8) mottles; moderate medium subangular blocky structure; firm; thin continuous clay films of very dark grayish brown (10YR 3/2) on surfaces of peds, in pores and in cracks; 5 percent pebbles; mildly alkaline; clear wavy boundary.

IIC—40 to 60 inches; brown (10YR 5/3) loam; few fine yellow (10YR 7/8) mottles; moderate fine subangular blocky structure; firm; light gray (10YR 7/1) streaks of lime; 3 percent pebbles; strong effervescence; moderately alkaline.

Depth to the IIC horizon ranges from 20 to 40 inches. Pebble content throughout the solum and the IIC horizon ranges from 1 to 7 percent. Reaction below the Ap horizon ranges from medium acid or slightly acid in the upper part of the solum and slightly acid to mildly alkaline in the lower part.

The Ap horizon ranges from very dark grayish brown (10YR 3/2) to very dark brown (10YR 2/2) moist, and grayish brown (10YR 5/2) dry. It is sandy loam, loamy fine sand, or fine sandy loam. Where present, the A1 horizon is very dark gray (10YR 3/1), very dark brown (10YR 2/2), or black (10YR 2/1). It is 2 to 4 inches thick. The A2 horizon is light brownish gray (10YR 6/2) or grayish brown (10YR 5/2) sand or sandy loam.

The B1 horizon is brown (10YR 5/3), grayish brown (10YR 5/2), or yellowish brown (10YR 5/4), and has mottles of low chroma. It is light sandy loam, loamy sand, or loamy coarse sand. The B2t horizon is light brownish gray (10YR 6/2), dark yellowish brown (10YR 4/4), or grayish brown (10YR 5/2). Thin continuous clay films on ped faces, in cracks, and in voids of the IIBt horizon also have low chroma. The B2t horizon is heavy sandy loam, sandy clay

loam, or light clay loam. There is a thin B3 or C horizon of loamy sand or light sandy loam 3 to 5 inches thick in some profiles.

The IIC horizon is brown (10YR 5/3), grayish brown (10YR 5/1), or light brownish gray (10YR 6/2) loam, silt loam, silty clay loam, or clay loam. Thin sandy strata, as much as 3 inches thick, occur in some places.

The Metamora soils in Clinton County have fewer gray mottles in the subsoil than is defined in the range of the series. This difference, however, does not alter the use and management of these soils.

Metamora soils are near Capac and Owosso soils. They are coarser in the upper part of the subsoil than Capac soils and have a mottled subsoil which Owosso soils lack.

MeA—Metamora-Capac sandy loams, 0 to 4 percent slopes. The nearly level and gently sloping soils in this mapping unit are Metamora sandy loam and Capac sandy loam. These soils occur next to each other in areas too small and intricately mixed to map separately. Individual areas range from 5 to about 100 acres in size. Slopes are short. This mapping unit is about 50 percent Metamora sandy loam and about 30 percent Capac sandy loam. Included in mapping are small areas of Parkhill and Corunna soils.

Seasonal wetness is the main limitation of these soils for farming. This mapping unit is well suited to such crops as corn, soybeans, and field beans and such small grains as wheat and oats, as well as forage crops. The soils, however, must be drained. Most areas are farmed. A few undrained areas are idle or used only as pasture. Others are wooded with mixed hardwoods. Limitations are severe for many nonfarm uses. Capability unit IIw–4(3/2b, 2.5b); woodland suitability group 2o4; woody plant group 2.

Metea Series

The Metea series consists of gently sloping, well drained soils on moraines, till plains, and lake plains.

In a representative profile the surface layer is dark grayish brown loamy sand 9 inches thick. The upper 15 inches of the subsoil is yellowish brown, very friable loamy sand. The middle 12 inches is dark yellowish brown, very friable loamy sand. The lower 4 inches of the subsoil is yellowish brown, firm, mottled clay loam. The underlying material at a depth of 40 inches is calcareous, mottled, yellowish brown light clay loam.

Runoff is slow to medium. Permeability is very rapid in the upper sandy material and moderately slow in the lower loamy layers. Available water capacity is moderate.

Metea soils are moderately well suited to farming. These soils are slightly limited for many nonfarm uses.

Representative profile of Metea loamy sand, 2 to 6 percent slopes, in a cultivated area 1,350 feet north and 1,410 feet east of the southwest corner of sec. 2, T. 8 N., R. 1 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) loamy sand; weak fine granular structure; very friable; many fine roots; neutral; abrupt smooth boundary.

B1—9 to 24 inches; yellowish brown (10YR 5/4) loamy sand; weak medium subangular blocky structure; very friable; slightly acid; clear wavy boundary.

B21—24 to 36 inches; dark yellowish brown (10YR 4/4) loamy sand; weak medium subangular blocky structure; very friable; medium acid; clear wavy boundary.

IIB22t—36 to 40 inches; yellowish brown (10YR 5/4) clay loam; few fine faint grayish brown (10YR 5/2) mottles; moderate coarse subangular blocky structure; firm; few thin and discontinuous dark grayish brown clay films (10YR 4/2) on surfaces of peds; neutral; clear wavy boundary.

IIC—40 to 60 inches; yellowish brown (10YR 5/4) light clay loam; common fine faint grayish brown (10YR 5/2) mottles; massive; firm; common medium distinct light gray (10YR 7/1) lime streaks and splotches; 5 percent pebbles; strong effervescence.

The solum is 30 to 48 inches thick. The B horizon is 30 to 40 inches thick. Reaction is medium acid to slightly acid in the Ap and B horizons and slightly acid or neutral in the IIB22 and IIC horizons.

The Ap horizon is dark grayish brown (10YR 4/2) or dark brown (10YR 4/3). In most cultivated areas, the A2 horizon is absent or is thin and discontinuous. Where present, it is brown (10YR 5/3) or grayish brown (10YR 5/2) sand or loamy sand and is 1 to 3 inches thick.

The B1 horizon is not present in all places. Where present, it is yellowish brown (10YR 5/4, 5/6) or brownish yellow (10YR 6/6, 6/8) loamy sand or sand. The B2 horizon is dark yellowish brown (10YR 4/4), strong brown (7.5YR 5/6), or yellowish brown (10YR 5/4) loamy sand, or in a few places light loamy sand that has an occasional ½ to 1 inch band of light sandy loam. The B horizon is subdivided into a B21 and B22 horizon in some profiles. The IIB2 horizon is yellowish brown (10YR 5/4, 5/6), dark yellowish brown (10YR 4/4), or brown (10YR 5/3) clay loam, sandy clay loam, or silty clay loam. Chroma is 2 or less in some places below a depth of 30 inches.

The IIC horizon is light clay loam, silty clay loam, or loam. Pebble content ranges from 1 to 8 percent. This horizon has strong or violent effervescence.

The color of the B horizon, the presence of mottles in the lower part of the subsoil, and the thickness of the lower part of the subsoil are outside the defined range for this series. These differences, however, do not alter use and management.

Metea soils in most landscapes are near Oakville, Owosso, and Selfridge soils. They are coarser textured in the upper part of the subsoil than Owosso soils. They lack the low chroma mottles in the upper part of the subsoil that are characteristic of Selfridge soils. In contrast with Oakville soils, Metea soils have clay loam underlying material.

MhB—Metea loamy sand, 2 to 6 percent slopes. This gently sloping soil is on foot slopes and narrow ridges. Individual areas are dominantly 5 to 15 acres in size but range from about 3 to 40 acres or more. Slopes are generally less than 200 feet long. Most areas are irregular in shape. A few areas on ridges and slopes of drainageways are long and narrow.

Included with this soil in mapping are a few small areas of Selfridge soils on the lower part of slopes. Wet spots and clayey spots less than 3 acres in size are identified by spot symbols on the soil map.

A shortage of available water during the growing season and an erosion hazard are the main limitations of this soil for farming. Most areas are farmed. This soil is moderately well suited to corn, field beans and soybeans, wheat, oats, and forage crops. A few areas are idle or wooded. Limitations are slight for most nonfarm uses. Capability unit IIIs–1(4/2a); woodland suitability group 2s5; woody plant group 3.

Morley Series

The Morley series consists of gently sloping to sloping, moderately well drained and well drained soils on till plains and moraines. These soils formed in calcareous loamy glacial till.

In a representative profile the surface layer is dark grayish brown loam 5 inches thick. The subsurface

layer is pale brown loam 6 inches thick. The upper 7 inches of the subsoil is yellowish brown, friable loam. The next 8 inches is dark yellowish brown, firm silty clay loam. The next 14 inches is dark brown, very firm, heavy silty clay loam, of which the lower 10 inches is mottled. The lower 4 inches of the subsoil is yellowish brown, firm, mottled silty clay loam. The calcareous underlying material at a depth of 44 inches is brown, mottled silty clay loam.

Runoff is medium to rapid. Permeability is moderately slow and slow. Available water capacity is high.

Morley soils are well suited to farming. These soils are severely to moderately limited for most nonfarm uses.

Representative profile of Morley loam, 2 to 6 percent slopes, in a wooded area 1,940 feet west and 200 feet north of the southeast corner of sec. 26, T. 6 N., R. 4 W.

A1—0 to 5 inches; dark grayish brown (10YR 4/2) loam; weak fine granular structure; friable; 3 percent pebbles; slightly acid; abrupt irregular boundary.

A2—5 to 11 inches; pale brown (10YR 6/3) loam; weak medium platy structure; friable; 3 percent pebbles; strongly acid; clear irregular boundary.

B1—11 to 18 inches; yellowish brown (10YR 5/4) loam; pale brown (10YR 6/3) coatings on surfaces of peds; weak medium subangular blocky structure; friable; pale brown coatings show slight evidence of interfingering but account for less than 15 percent of the volume; grading to clay loam texture; 3 percent pebbles; strongly acid; clear wavy boundary.

B21t—18 to 26 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate medium angular blocky structure; firm; 3 percent pebbles; strongly acid; clear wavy boundary.

B22t—26 to 30 inches; dark brown (10YR 4/3) heavy silty clay loam; strong medium angular blocky structure; very firm; surfaces of peds have thin continuous brown (10YR 5/3) clay films; 3 percent pebbles; medium acid; gradual wavy boundary.

B23t—30 to 40 inches; dark brown (10YR 4/3) heavy silty clay loam; few fine faint yellowish brown (10YR 5/4) and common medium distinct strong brown (7.5YR 5/8) mottles; strong medium structure parting to fine angular blocky; very firm; surfaces of peds, cracks, and voids have dark brown clay accumulations; grading to silty clay texture; 3 percent pebbles; slightly acid; clear wavy boundary.

B3—40 to 44 inches; yellowish brown (10YR 5/4) silty clay loam; many medium distinct strong brown (7.5YR 5/8) mottles; strong medium angular blocky structure; firm; 3 percent pebbles; neutral; gradual wavy boundary.

C—44 to 60 inches; brown (10YR 5/3) silty clay loam; many medium distinct brownish yellow (10YR 6/8) mottles; many fine distinct light gray (10YR 7/1) streaks; strong fine angular blocky structure; very firm; 3 percent pebbles; strong effervescence; moderately alkaline.

The solum is dominantly 30 to 44 inches thick, but ranges from 24 to 48 inches. Pebble content throughout the profile ranges from 1 to 10 percent.

Where present, the A1 horizon is dark grayish brown (10YR 4/2), very dark grayish brown (10YR 3/2), or very dark gray (10YR 3/1). In cultivated areas the Ap horizon is dark grayish brown (10YR 4/2), brown (10YR 4/3), or very dark grayish brown (10YR 3/2) loam 7 to 10 inches thick. The A2 horizon is absent in most cultivated areas, but it is commonly evident in the upper part of the B horizon as a coating on surfaces of peds, in cracks, and in voids.

The finest textured part of the B horizon is heavy silty clay loam or light silty clay. The C horizon is clay loam or silty clay loam.

Morley soils in most landscapes are near Blount and Marlette soils. They are mottled in the lower part of the subsoil, whereas Blount soils are mottled throughout the subsoil. Morley soils have a finer textured subsoil and underlying material than Marlette soils.

MoB—Morley loam, 2 to 6 percent slopes. This gently sloping soil is on the upper part of side slopes on the broad till plains. It has the profile described as representative of the series. Individual areas range from about 5 to 30 acres in size. They are dominantly long and narrow and are roughly parallel with the drainage pattern. Included in mapping are a few small areas of Blount soils in minor depressions, on lower parts of side slopes, and in narrow waterways.

Water erosion, moderately slow permeability, and seasonal wetness are the main limitations of this soil for farming.

Most areas are farmed. If well managed, this soil is well suited to such crops as corn, field beans and soybeans, wheat, oats, and forage. A few areas are wooded with mixed upland hardwoods. Limitations are moderate to severe for most nonfarm uses. Capability unit IIe–1(1.5a); woodland suitability group 2o2; woody plant group 3.

MoC—Morley loam, 6 to 12 percent slopes. This sloping soil is on broad till plains. Most areas are long and narrow and range from 5 to 20 acres. Slopes are generally short, but a few are more than 200 feet long. This soil has a profile similar to the one described as representative of the series, but it lacks mottles in the lower part of the subsoil. Included in mapping are small areas of Blount soils in depressions, on the lower part of side slopes, and in drainageways.

Erosion and moderately slow permeability are the main problems for farming. If well managed, this soil is suited to such crops as corn, field beans and soybeans, wheat, oats, and forage. Most areas are farmed. A few areas are wooded with mixed hardwoods. Others are idle or pastured. Limitations are moderate to severe for many nonfarm uses. Capability unit IIIe–1 (1.5a); woodland suitability group 2o2; woody plant group 3.

Oakville Series

The Oakville series consists of nearly level and gently sloping, well drained, and moderately well drained soils on outwash plains, till plains, and old sandy beach ridges. These soils formed in fine sand.

In a representative profile the surface layer is very dark grayish brown fine sand 8 inches thick. The subsoil is dark yellowish brown and yellowish brown, loose fine sand 28 inches thick. The underlying material, beginning at a depth of 36 inches, is pale brown fine sand.

Runoff is very slow. Permeability is very rapid. Available water capacity is low.

Some areas of Oakville soils are cultivated. Others are idle or wooded. These soils are poorly suited to farming. They are slightly to severely limited for nonfarm uses.

Representative profile of Oakville fine sand, 0 to 6 percent slopes, in a cultivated area 2,010 feet west and 75 feet north of the southeast corner of sec. 5, T. 8 N., R. 2 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) fine sand; weak fine granular structure; very fri-

able; many fine roots; slightly acid; abrupt smooth boundary.
B21—8 to 15 inches; dark yellowish brown (10YR 4/4) fine sand; single grained; loose; few fine roots; slightly acid; clear wavy boundary.
B22—15 to 24 inches; yellowish brown (10YR 5/4) fine sand; single grained; loose; few fine roots; slightly acid; clear wavy boundary.
B3—24 to 36 inches; yellowish brown (10YR 5/4) fine sand; single grained; loose; neutral; clear wavy boundary.
C—36 to 60 inches; pale brown (10YR 6/3) fine sand; single grained; loose; neutral.

The solum is dominantly 24 to 36 inches thick, but ranges from 20 to 40 inches. Reaction is dominantly slightly acid, but ranges from medium acid to neutral.

The Ap horizon is very dark grayish brown (10YR 3/2), dark yellowish brown (10YR 3/4), dark grayish brown (10YR 4/2), and very dark gray (10YR 3/1). The A1 horizon, where present, is black (10YR 2/1) or very dark brown (10YR 2/2), and is 1 to 3 inches thick. In most undisturbed areas, there is an A2 horizon of brown (10YR 5/3) fine sand 4 to 6 inches thick.

The B2 horizon ranges from dark yellowish brown (10YR 4/4) or strong brown (7.5YR 5/6) to yellowish brown (10YR 5/4, 5/6, 5/8). The B3 horizon is light yellowish brown (10YR 6/4), yellowish brown (10YR 5/4, 5/6), or brown (10YR 5/3).

The C horizon is pale brown (10YR 6/3), brown (10YR 5/3), or light yellowish brown (10YR 6/4). It is typically fine sand, but in some profiles it is medium sand below a depth of 40 inches. Thin, discontinuous color bands from ¼ to 2 inches thick are below a depth of 40 inches in places.

Oakville soils in most landscapes are near Metea and Spinks soils. They lack the fine textured underlying material characteristic of Metea soils. They are coarser textured than Spinks soils and lack the loamy sand or sandy loam bands in the subsoil characteristic of Spinks soils.

OaB—Oakville fine sand, 0 to 6 percent slopes. This nearly level and gently sloping soil is on old beach ridges and plains bordering large drainage channels. Slopes range from 50 to 175 feet in length and are complex. Most areas of this soil range from 5 to 20 acres in size. Small areas of Metea soils are included with this soil in mapping where it borders the uplands. Also included are long narrow ridges where slopes are 6 to 18 percent. They are identified by spot symbols on the soil maps.

Droughtiness and the hazard of soil blowing are the main limitations. This soil is poorly suited to farming. Most areas are cleared and are idle or pastured or wooded with mixed hardwoods. Conifers have been planted in a few areas to be used for Christmas trees or timber products. Limitations are slight to severe for nonfarm uses. Capability unit IVs–1(5a); woodland suitability group 2s9; woody plant group 3.

Oshtemo Series

The Oshtemo series consists of gently sloping, well drained soils on outwash plains and moraines. These soils formed in sandy and loamy material.

In a representative profile the surface layer is dark grayish brown sandy loam 7 inches thick. The subsurface layer is brown sandy loam 7 inches thick. The subsoil, to a depth of 55 inches, is strong brown, friable heavy sandy loam, light sandy loam, and loamy sand. The underlying material is grayish brown, stratified coarse sand and gravel.

Runoff is slow. Permeability is moderately rapid. Available water capacity is moderate.

Oshtemo soils are moderately well suited to farming. They are slightly limited for many nonfarm uses.

Representative profile of Oshtemo sandy loam, 2 to 6 percent slopes, in a cultivated field 500 feet north and 200 feet west of the southeast corner of sec. 21, T. 6 N., R. 1 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) sandy loam; weak medium granular structure; very friable; many fine roots; 5 percent pebbles; slightly acid; abrupt wavy boundary.
A2—7 to 14 inches; brown (10YR 5/3) sandy loam; weak fine subangular blocky structure; very friable; few fine roots; 5 percent pebbles; slightly acid; abrupt wavy boundary.
B21t—14 to 26 inches; strong brown (7.5YR 5/6) heavy sandy loam; moderate coarse subangular blocky structure; friable; 5 percent pebbles; strongly acid; clear wavy boundary.
B22t—26 to 41 inches; strong brown (7.5YR 5/6) light sandy loam; weak coarse subangular blocky structure; very friable; some clay bridging between sand grains and dark brown (7.5YR 3/2) clay films on pebbles; 5 percent pebbles; strongly acid; gradual wavy boundary.
B3—41 to 55 inches; strong brown (7.5YR 5/6) loamy sand; massive; very friable; 1 to 3 inch discontinuous bands of reddish brown (5YR 4/4) sandy loam; 14 percent pebbles; slightly acid.
IIC—55 to 60 inches; grayish brown (10YR 5/2) stratified coarse sand and gravel; single grained; loose; strong effervescence; moderately alkaline.

The solum ranges from 40 to 66 inches in thickness. Pebble content in the solum is dominantly 5 to 20 percent, but ranges from 1 to 30 percent.

The Ap horizon ranges from dark grayish brown (10YR 4/2) to brown (10YR 5/3). The A1 horizon, where present, is very dark grayish brown (10YR 3/2). It is 1 to 4 inches thick. The A2 horizon is brown (10YR 5/3) or yellowish brown (10YR 5/4) loamy sand or sandy loam.

The Bt horizon has hue of 5YR, 7.5YR, or 10YR, value of 3 through 5, and chroma of 3 through 6. It is heavy sandy loam, sandy loam, gravelly sandy loam, sandy clay loam, or gravelly sandy clay loam. In the lower part of the solum in some places, the Bt horizon is in layers ⅛ to 4 inches thick separated by loamy sand. Reaction is slightly acid or neutral in the lower part of the B horizon in some profiles.

The IIC horizon is dominantly coarse sand and gravel. It is commonly effervescent throughout the profile, but in some places the upper part is slightly acid and becomes strongly effervescent as depth increases.

Oshtemo soils in most landscapes are near Boyer and Lapeer soils. They have a thicker solum than Boyer and Lapeer soils. In addition, they are underlain by sand and gravel, whereas Lapeer soils are underlain by sandy loam.

OsB—Oshtemo sandy loam, 2 to 6 percent slopes. This gently sloping soil is on benches bordering major stream channels. Individual areas range from 20 to 40 acres in size. They are long and narrow and are roughly parallel to stream channels. A few areas on broad interstream divides range to as much as 80 acres or more in size. They are irregular in shape.

Included with this soil in mapping are small areas that have a surface layer of loamy sand. Wet spots less than 3 acres in size are identified by spot symbols on the soil map.

Droughtiness and the hazards of water erosion and soil blowing are the main limitations. This soil is moderately well suited to farming. Corn, field beans, wheat, oats, and forage are the chief crops. Some areas are idle or pastured. A few are wooded. Others are a source of sand and gravel. Limitations are slight for many nonfarm uses. Capability unit IIIs–1(4a); woodland suitability group 2s5; woody plant group 3.

Owosso Series

The Owosso series consists of nearly level to sloping, well drained soils on till plains and moraines. These soils formed in sandy loam 20 to 40 inches thick and in calcareous underlying loamy glacial till.

In a representative profile the surface layer is brown sandy loam 9 inches thick. The subsurface layer is pale brown sandy loam 3 inches thick. The upper 14 inches of the subsoil is yellowish brown, friable sandy loam. The lower 12 inches is yellowish brown and dark yellowish brown, friable and firm, heavy loam and clay loam. The underlying material at a depth of 38 inches is brown heavy loam.

Runoff is slow to rapid. Permeability is moderately rapid in the sandy loam upper material and moderately slow in the clay loam underlying material. Available water capacity is moderate.

Owosso soils are farmed intensively and are well suited to this use. They have a high potential for growing timber. These soils are slightly to moderately limited for most nonfarm uses.

Representative profile of Owosso sandy loam, in an area of Owosso-Marlette sandy loams, 2 to 6 percent slopes, in a cultivated area 750 feet north and 1,920 feet east of the southwest corner of sec. 10, T. 6 N., R. 1 W.

Ap—0 to 9 inches; brown (10YR 4/3) sandy loam; moderate medium granular structure; friable; 5 percent pebbles; slightly acid; abrupt smooth boundary.

A2—9 to 12 inches; pale brown (10YR 6/3) sandy loam; weak medium granular structure; very friable; 5 percent pebbles; slightly acid; clear irregular boundary.

B1—12 to 23 inches; yellowish brown (10YR 5/4) sandy loam; weak medium subangular blocky structure; friable; 5 percent pebbles; slightly acid; clear wavy boundary.

B21t—23 to 26 inches; yellowish brown (10YR 5/4) heavy sandy loam; weak medium subangular blocky structure; friable; 2 percent pebbles; slightly acid; clear wavy boundary.

IIB22t—26 to 34 inches; yellowish brown (10YR 5/4) clay loam; moderate medium subangular blocky structure; firm; 5 percent pebbles; slightly acid; clear wavy boundary.

IIB3—34 to 38 inches; dark yellowish brown (10YR 4/4) heavy loam; weak medium subangular blocky structure; friable; 5 percent pebbles; neutral; clear wavy boundary.

IIC—38 to 60 inches; brown (10YR 5/3) heavy loam; few fine faint yellowish brown (10YR 5/6) mottles; massive; friable; 5 percent pebbles; slight effervescence; mildly alkaline.

The solum is 24 to 50 inches thick. Pebble content ranges from 1 to 10 percent throughout the profile. Reaction in the solum ranges from slightly acid to strongly acid.

The Ap horizon ranges from brown (10YR 4/3, 5/3) to dark grayish brown (10YR 4/2). The A1 horizon, where present, is very dark gray (10YR 3/1) sandy loam 2 to 4 inches thick. The A2 horizon ranges from pale brown (10YR 6/3) to yellowish brown (10YR 5/4) sandy loam.

The B1 horizon is dominantly yellowish brown (10YR 5/4), dark brown (10YR 4/3), or dark yellowish brown (10YR 4/4). It is sandy loam, light sandy loam, or heavy loamy sand. The IIBt horizon is yellowish brown (10YR 5/4) or dark yellowish brown (10YR 4/4) clay loam, silty clay loam, or heavy loam.

The IIC horizon is commonly loam, but in places it is silt loam, light silty clay loam, or light clay loam till. Effervescence is slight to strong.

Owosso soils in most landscapes are near Metamora, Metea, and Marlette soils. They lack the mottled subsoil characteristic of Metamora soils. They are finer textured in the upper part of the subsoil than Metea soils and are coarser textured in the upper part of the subsoil than Marlette soils.

OtA—Owosso sandy loam, 0 to 2 percent slopes. This nearly level soil is on till plains. Individual areas are small and are irregular in shape. They are above more sloping areas. Included in mapping are small areas of gently sloping Owosso soils along drainageways.

Slight droughtiness late in the growing season is the main limitation. Most areas are farmed. The soil is well suited to row crops, small grain, and forage. Crop growth is slow during prolonged dry periods. Limitations are slight to moderate for many nonfarm uses. Capability unit IIs–1(3/2a); woodland suitability group 1o1; woody plant group 3.

OwB—Owosso-Marlette sandy loams, 2 to 6 percent slopes. The gently sloping soils in this complex are Owosso sandy loam and Marlette sandy loam. These soils are adjacent in areas too small and intricately associated to be mapped separately. Individual areas range from about 10 to 25 acres in size. This complex occupies the intermediate position between the outwash plains and the glacial till plains. Other areas are on relatively broad uplands between old glacial drainage channels and muck filled basins.

This complex is 55 percent Owosso sandy loam and 40 percent Marlette sandy loam. The Owosso soil has the profile described as representative of the series. The Marlette soil has a profile similar to the one described as representative of the series, but the surface layer is sandy loam. Included in mapping are small areas of Corunna and Parkhill soils in depressions and in narrow drainageways.

Erosion is the main problem. The Owosso soil is droughty late in the growing season. Most of the acreage is farmed. Corn, beans, wheat, oats, and forage are well suited. Uneven growth and uneven maturity of crops can be a slight limitation during prolonged dry seasons. Some areas are wooded with mixed hardwoods. Limitations are slight to severe for nonfarm uses. Owosso soil in capability unit IIe–3(3/2a), woodland suitability group 1o1; Marlette soil in capability unit IIe–3(2.5a), woodland suitability group 2o1; woody plant group 3.

OwC—Owosso-Marlette sandy loams, 6 to 12 percent slopes. The sloping soils in this complex are Owosso sandy loam and Marlette sandy loam. These soils are adjacent in areas too small and intricately associated to be mapped separately. Individual areas range from about 5 to 15 acres in size. This complex occupies sloping areas along drainage channels and along wet, basinlike depressions. Individual areas are long and narrow. Slopes are typically short and convex. They are rarely more than 200 feet long.

This complex is 50 percent Owosso sandy loam and 40 percent Marlette sandy loam. The Marlette soil has a profile similar to the one described as representative of the series, but the surface layer is sandy loam.

Erosion is the main problem. The Owosso soil is droughty late in the growing season. Most of the acreage is farmed. Corn, beans, wheat, oats, and forage crops are moderately well suited. Uneven growth and uneven maturity of crops is a slight limitation during prolonged dry seasons. Some areas are wooded with mixed hardwoods. Limitations are slight to severe for

nonfarm uses. Owosso soil in capability unit IIIe–3 (3/2a), woodland suitability group 1o1; Marlette soil in capability unit IIIe–3(2.5a), woodland suitability group 2o1; woody plant group 3.

Palms Series

The Palms series consists of nearly level, very poorly drained soils in broad, low, wet drainage channels, in lake basins, and on depressed uplands. These soils formed in organic material 16 to 50 inches thick. The organic deposits are underlain by loamy mineral material.

In a representative profile the soil is black muck to a depth of 41 inches. The upper 13 inches of the underlying material is calcareous, dark gray silt loam. The lower part to a depth of 60 inches is calcareous, greenish gray silt loam.

Runoff is very slow to ponded. Permeability is moderately slow to moderately rapid in the organic material and moderate in the underlying mineral material. Available water capacity is very high.

Palms soils are well suited to vegetables and other special crops if wetness, the hazards of frost and soil blowing, low natural fertility, and instability of the organic material can be overcome. They are severely limited for most nonfarm uses.

Representative profile of Palms muck in an idle field 1,110 feet south and 500 feet west of the northeast corner of sec. 26, T. 6 N., R. 4 W.

Oa1—0 to 9 inches; black (N 2/0 broken face and rubbed) sapric material; less than 5 percent fiber; moderate medium granular structure; friable; slightly acid; gradual wavy boundary.

Oa2—9 to 18 inches; black (5YR 2/1 broken face and rubbed) sapric material; approximately 10 percent fiber, less than 5 percent rubbed; moderate medium platy structure; firm; fibers are herbaceous; slightly acid; clear wavy boundary.

Oa3—18 to 35 inches; black (5YR 2/1 broken face and rubbed) sapric material; approximately 20 percent fiber, 5 percent rubbed; weak medium platy structure; friable; fibers are herbaceous; neutral; clear smooth boundary.

Oa4—35 to 41 inches; black (5YR 2/1 broken face and rubbed) sapric material; 5 to 10 percent fiber, less than 5 percent rubbed; massive; friable; fibers dominantly herbaceous; about 5 percent mineral content; neutral; abrupt wavy boundary.

IIC1g—41 to 54 inches; dark gray (5Y 4/1) silt loam; massive; friable; slight effervescence; mildly alkaline.

IIC2g—54 to 60 inches; greenish gray (5GY 5/1) silt loam; massive; friable; strong effervescence; moderately alkaline.

The organic material is dominantly 24 to 42 inches thick, but ranges from 16 to 50 inches. It is predominantly herbaceous. Most soils have some woody material and also have a 1- to 2-inch layer of sedimentary peat just above the underlying mineral material. Reaction is slightly acid, neutral, or mildly alkaline below the surface layer.

The surface layer is primarily black (N 2/0, 5YR 2/1, 7.5YR 2/1, 10YR 2/1) or very dark brown (10YR 2/2) sapric material.

The subsurface and lower layers are black (5YR 2/1, 7.5YR 2/1, 10YR 2/1) or very dark brown (10YR 2/2). Most soils are dominantly sapric material, but have thin layers of dark reddish brown (5YR 3/3) or black (5YR 2/1) hemic material. The thin limnic layers of sedimentary peat are black (2.5YR 2/0 or 5Y 2/1, 2/2), very dark gray (5Y 3/1), or dark olive gray (5Y 3/2). The IIC horizon is loam, silt loam, light clay loam, or light silty clay loam. Reaction in the IIC horizon ranges from neutral to strongly alkaline. Effervescence is none to violent.

Palms soils are similar to Adrian, Edwards, and Houghton soils. They are underlain by loam within a depth of 50 inches, whereas Adrian soils are underlain by sand, Edwards soils are underlain by marl. Houghton soils are underlain by more than 50 inches of organic material.

Pa—Palms muck. This nearly level soil is in broad, low wet drainage channels and in lake basins. It also occurs in small, wet, concave depressions in the uplands. In places it occurs between Parkhill and Houghton soils. Individual areas range from about 5 to more than 100 acres in size. The larger areas are mainly in old glacial lake basins and drainageways. Most areas are irregular in shape. Slopes are 0 to 2 percent. Included in mapping are small areas where the organic material is less than 16 inches deep over the loamy substratum.

Wetness, the hazard of frost and soil blowing, and the poor stability of the organic material are the main problems. Some areas have been cleared, drained, and farmed. Others are idle or pastured.

If well managed, this soil is well suited to such vegetables as carrots, celery, and onions or to such special crops as mint and grass sod. Small areas are used for corn and soybeans. Some areas are wooded with slow-growing, poor-quality lowland hardwoods. Limitations are severe for most nonfarm uses. Capability unit IIw–5(M/3c); woodland suitability group 4w2; woody plant group 1.

Parkhill Series

The Parkhill series consists of nearly level, very poorly drained and poorly drained soils on till plains and moraines. These soils formed in loamy glacial till.

In a representative profile the surface layer is very dark gray loam about 9 inches thick. The upper 13 inches of the subsoil is dark grayish brown, friable, mottled heavy loam. The middle 8 inches is mottled, grayish brown, firm clay loam. The lower 5 inches is mottled, gray, friable, heavy loam. The underlying material at a depth of 35 inches is calcareous gray loam till.

Runoff is very slow to ponded. Permeability is moderately slow. Available water capacity is high.

If adequately drained, Parkhill soils are well suited to farming. They are severely limited for most nonfarm uses.

Representative profile of Parkhill loam in a cultivated area 123 feet south and 930 feet east of the northwest corner of sec. 8, T. 7 N., R. 1 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) loam; moderate medium granular structure; friable; 3 percent pebbles; neutral; abrupt smooth boundary.

B1g—9 to 22 inches; dark grayish brown (10YR 4/2) heavy loam; common fine distinct yellowish brown (10YR 5/6) and common medium grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; friable; 3 percent pebbles; neutral; clear wavy boundary.

B21g—22 to 30 inches; grayish brown (10YR 5/2) clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; 5 percent pebbles; neutral; clear wavy boundary.

B22g—30 to 35 inches; gray (10YR 5/1) heavy loam; many coarse distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; 5 percent pebbles; friable; neutral; clear wavy boundary.

Cg—35 to 60 inches; gray (10YR 6/1) loam; many medium grayish brown (10YR 5/2) mottles and many medium yellowish brown (10YR 5/6) mottles; massive; friable; 5 percent pebbles; slight effervescence; mildly alkaline.

The solum is dominantly 30 to 42 inches thick but ranges from 20 to 45 inches. Pebble content throughout the profile ranges from 1 to 10 percent. Reaction in the solum is typically neutral to mildly alkaline but is slightly acid in places.

The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) loam, but profiles that have silt loam and clay loam occur in some places.

The Bg horizon ranges in hue from 10YR, 5Y, and 2.5Y to neutral. Value is 4, 5, or 6, and chroma is 1 to 2. Texture is loam, heavy loam, light clay loam, or light silty clay loam.

The C horizon is predominantly loam, but is light clay loam in places.

Parkhill soils in most landscapes are near Colwood, Corunna, and Sims soils. They lack the stratification characteristic of Colwood soils. They have a finer textured solum than Corunna soils and a coarser textured solum than Sims soils.

Pr—Parkhill loam. This nearly level soil is on low till plains and in depressions. Individual areas range from 2 to 10 acres in size in the depressions to 80 to 100 acres or more on the broad till plains. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas of Capac soils. Small sand spots are identified by spot symbols on the soil map.

Wetness is the main limitation. If adequately drained, this soil is well suited to such crops as corn, soybeans, sugar beets, wheat, and forage. Most areas are farmed. Trees grow slowly on this soil. Some woodlots of low quality are pastured. Limitations are severe for most nonfarm uses. Capability unit IIw–1 (2.5c); woodland suitability group 2w1; woody plant group 2.

Sebewa Series

The Sebewa series consists of nearly level, very poorly drained and poorly drained soils on outwash plains and lake plains and in glacial drainageways. These soils formed in loamy glaciofluvial deposits.

In a representative profile the surface layer is black loam 11 inches thick. The subsoil is gray, firm, mottled loam, clay loam, and gravelly clay loam 28 inches thick. The underlying material at a depth of 39 inches is grayish brown gravel and sand.

Runoff is very slow. Permeability is moderate to a depth of 39 inches and rapid below. Available water capacity is moderate.

If artificially drained, Sebewa soils are well suited to farming. Most areas are cultivated. Artificial drainage may be difficult to install because of the gravel and sand underlying material. These soils are a possible source of sand and gravel. They are severely limited for nonfarm uses.

Representative profile of Sebewa loam in a cultivated field 1,740 feet south and 250 feet west of the northeast corner of sec. 13, T. 7 N., R. 2 W.

Ap—0 to 11 inches; black (10YR 2/1) loam; moderate medium granular structure; friable; 6 percent pebbles; neutral; abrupt smooth boundary.

B1g—11 to 18 inches; gray (10YR 5/1) loam; few fine distinct yellowish brown (10YR 5/4) mottles and few medium faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; 6 percent pebbles; neutral; clear wavy boundary.

B21tg—18 to 32 inches; gray (10YR 5/1) light clay loam; many fine distinct yellowish brown (10YR 5/4, 5/6) mottles; moderate medium angular blocky structure; firm; few clay films; 10 percent pebbles; neutral; clear wavy boundary.

B22tg—32 to 39 inches; gray (10YR 6/1) gravelly clay loam; common medium distinct yellowish brown (10YR 5/4, 5/6) mottles; massive; firm; few clay films; 18 percent pebbles; neutral; clear wavy boundary.

IIC1g—39 to 52 inches; grayish brown (10YR 5/2) sand; single grained; loose; slight effervescence; mildly alkaline.

IIC2g—52 to 60 inches; grayish brown (10YR 5/2) gravel and sand; single grained; loose; 50 percent pebbles; strong effervescence; moderately alkaline.

Thickness of the solum and depth to carbonates range from 24 to 40 inches. Pebble content ranges from 2 to 20 percent. Reaction ranges from slightly acid to mildly alkaline.

The Ap horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark gray (10YR 3/1) sandy loam or clay loam. Where there is an A12 horizon, the total thickness of the Ap and A12 horizons is at least 10 inches. The A1 horizon is 10 to 14 inches thick.

The B horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 through 6, and chroma of 1 or 2. It is heavy loam, gravelly clay loam, sandy clay loam, or clay loam. In places there is a B3 horizon of sandy loam or loamy sand above the IIC horizon. The IIC horizon has hue of 10YR, 2.5Y, or 5Y, value of 5 or 6, and chroma of 1 or 2. It is gravel, coarse sand, or stratified sand and gravel.

Sebewa soils in most landscapes are near Gilford and Matherton soils. They have a finer textured solum than Gilford soils and a gray subsoil, whereas Matherton soils have a grayish brown subsoil.

Sb—Sebewa loam. This nearly level soil is in depressed areas in drainageways, on wet outwash plains, and in old glacial spillways. Individual areas range from about 3 to 80 acres or more in size. Most areas are irregular in shape. A few areas that border upland drainageways are long and narrow. Slopes are 0 to 2 percent.

Included with this soil in mapping are small gently sloping areas of Matherton soils in some places. Also included are some small areas where the subsoil is silty.

Sebewa loam is wet and has a seasonal high water table. It requires artificial drainage for most crops. If well managed, it is well suited to cultivated crops. Some undrained areas are used only for pasture. Others are wooded with poor-quality lowland hardwoods. A few areas are used as a source of sand and gravel. Limitations are severe for most nonfarm uses. Capability unit IIw–3 (3/5c); woodland suitability group 2w1; woody plant group 2.

Selfridge Series

The Selfridge series consists of nearly level and gently sloping, somewhat poorly drained soils on till plains, moraines, and in old lake beds.

In a representative profile the surface layer is very dark grayish brown loamy sand 10 inches thick. The subsurface layer is brown loamy sand 4 inches thick. The upper 8 inches of the subsoil is yellowish brown, very friable, mottled loamy sand. The middle 5 inches is dark brown, friable, mottled sandy loam. The lower 7 inches is yellowish brown, firm, mottled light clay

loam. The calcareous underlying material, at a depth of 34 inches, is brown loam.

Runoff is slow. Permeability is rapid in the upper 20 to 40 inches of sandy material and moderate and moderately slow in the loamy underlying material. Available water capacity is moderate.

If adequately drained Selfridge soils are moderately well suited to farming. They are severely limited for most nonfarm uses.

Representative profile of Selfridge loamy sand, 0 to 4 percent slopes, in a cultivated area 1,100 feet east and 900 feet north of the southwest corner of sec. 2, T. 8 N., R. 1 W.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) loamy sand; weak medium granular structure; very friable; few fine roots; slightly acid; abrupt smooth boundary.

A2—10 to 14 inches; brown (10YR 5/3) loamy sand, many medium distinct dark grayish brown (10YR 4/2) streaks; weak medium subangular blocky structure; very friable; medium acid; clear irregular boundary.

B1—14 to 22 inches; yellowish brown (10YR 5/4) loamy sand; many medium yellowish brown (10YR 5/6) concretions and few fine distinct dark reddish brown (5YR 3/4) concretions; weak medium subangular blocky structure; very friable; slightly acid; clear irregular boundary.

B21t—22 to 27 inches; dark brown (10YR 4/3) sandy loam; many medium distinct strong brown (7.5YR 5/6) mottles and a few fine faint pale brown (10YR 6/3) mottles; moderate coarse subangular blocky structure; friable; 3 percent pebbles; medium acid; clear wavy boundary.

IIB22t—27 to 34 inches; yellowish brown (10YR 5/6) light clay loam; many medium distinct grayish brown (10YR 5/2) mottles and few fine faint pale brown (10YR 6/3) mottles; moderate medium angular blocky structure; firm; 5 percent pebbles; neutral; clear wavy boundary.

IIC—34 to 60 inches; brown (10YR 5/3) loam; common medium light gray (10YR 7/1) mottles and common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure; 5 percent pebbles; friable; slight effervescence; mildly alkaline.

The solum is 30 to 40 inches thick, and depth to effervescent material is 30 to 40 inches.

The Ap horizon is very dark grayish brown (10YR 3/2) or very dark brown (10YR 2/2) loamy sand or sandy loam. The A2 horizon is brown (10YR 5/3) or grayish brown (10YR 5/2) loamy sand or sand 2 to 4 inches thick.

The B1 horizon ranges from yellowish brown (10YR 5/4, 5/6) to brown (10YR 5/3) loamy sand or sand. The B21 horizon is dark brown (10YR 4/3) or dark yellowish brown (10YR 4/4) sandy loam or loamy sand. The B horizon has low chroma mottles above a depth of 30 inches. The IIBt horizon is light clay loam, loam, sandy clay loam, or gravelly sandy clay loam. In places the lower part of the solum is as much as 25 percent gravel.

The IIC horizon ranges from loam to silty clay loam. The C horizon has thin layers and small pockets of sandy loam, silt, or fine sand below a depth of 40 inches in some places.

Selfridge soils in most landscapes are near Metea and Metamora soils. They have mottles throughout the subsoil, whereas Metea soils do not. They are coarser textured in the upper part of the subsoil than Metamora soils.

SeA—Selfridge loamy sand, 0 to 4 percent slopes. This nearly level and gently sloping soil is on broad plains, terraces, and uplands. On the uplands and till plains it occurs as irregularly shaped areas on foot slopes and as long, narrow areas on low lying beach ridges. Individual areas range from about 5 to 20 acres in size.

Included with this soil in mapping are some small areas of Metea soils.

Wetness and low available water capacity in the upper sandy part of the soil are the main limitations. If adequately drained the soil is moderately well suited to corn, beans, wheat, oats, and forage crops. Some areas are wooded with mixed hardwoods. Many woodlots are pastured. Limitations are severe for most nonfarm uses. Capability unit IIIw–1 (4/2b); woodland suitability group 3s3; woody plant group 2.

Shoals Series

The Shoals series consists of nearly level, somewhat poorly drained soils on flood plains. These soils formed in loamy alluvium.

In a representative profile the surface layer is dark grayish brown loam 9 inches thick. The upper 10 inches of the subsoil is grayish brown, friable, mottled loam. The lower 19 inches of the subsoil is yellowish brown, firm, mottled light silty clay loam. The calcareous underlying material begins at a depth of 38 inches. The upper 13 inches is grayish brown, mottled loam. The lower part to a depth of 60 inches is stratified, grayish brown fine sandy loam, loamy fine sand, and silt loam.

Runoff is very slow, and the soil is subject to flooding. Permeability is moderate. Available water capacity is high.

Shoals soils are well suited to farming if they are adequately drained and if the hazard of seasonal flooding is overcome. Many areas of these soils are wooded. Some are in permanent grass. These soils are severely limited for most nonfarm uses.

Representative profile of Shoals loam, in a cultivated area 492 feet north and 261 feet west of the southeast corner of sec. 10, T. 8 N., R. 4 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) loam; moderate medium granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

B1—9 to 19 inches; grayish brown (10YR 5/2) loam; many medium distinct yellowish brown (10YR 5/4) mottles and many medium prominent dark reddish brown (5YR 3/4) mottles; weak medium subangular blocky structure; friable; neutral; abrupt smooth boundary.

B21—19 to 30 inches; yellowish brown (10YR 5/4) light silty clay loam; few fine faint grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; neutral; clear wavy boundary.

B22—30 to 38 inches; yellowish brown (10YR 5/6) light silty clay loam; common fine distinct gray (10YR 5/1) mottles; few fine distinct very dark grayish brown (10YR 3/2) organic stains; moderate medium subangular blocky structure; firm; neutral; clear wavy boundary.

C1g—38 to 51 inches; grayish brown (10YR 5/2) loam; many coarse distinct yellowish brown (10YR 5/6) mottles; massive; friable; mildly alkaline; slight effervescence.

C2g—51 to 60 inches; grayish brown (10YR 5/2) stratified fine sandy loam, loamy fine sand, and silt loam; many medium distinct yellowish brown mottles; massive; very friable; slight effervescence; mildly alkaline.

The solum is 30 to 40 inches thick. Organic matter staining and accumulation decreases irregularly throughout the B horizon and the upper part of the C horizon. Reaction throughout the solum is neutral or mildly alkaline.

The A horizon is dark grayish brown (10YR 4/2), very

dark grayish brown (10YR 3/2), or dark brown (10YR 3/3, 4/3).

The B horizon is grayish brown (10YR 5/2), yellowish brown (10YR 5/4, 5/6), dark grayish brown (10YR 4/2), or brownish yellow (10YR 6/8) loam, silt loam, or light silty clay loam that has strata of fine sandy loam or light clay loam.

The C horizon is fine sandy loam, sandy loam, loam, or silt loam that has thin strata of sand, loamy sand, clay loam, or silty clay loam.

The Shoals soils in most landscapes are near Sloan, Ceresco and Cohoctah soils. They lack the overall gray colors in the subsoil that are characteristic of Sloan soils. They are finer textured throughout the subsoil than Ceresco and Cohoctah soils.

Sh—Shoals loam. This nearly level soil is on second bottoms on the large flood plains and on first bottoms on the smaller flood plains. Individual areas range from about 5 to 60 acres or more in size. Slopes are 0 to 2 percent. Included in mapping are small, wet depressions and old abandoned channels occupied by Sloan soils.

Shoals loam has a seasonal high water table and is subject to flooding. This soil is well suited to farming if problems can be overcome. Most areas on first bottoms are in permanent grass or are wooded. Some areas on second bottoms are cleared and used for such row crops as corn and beans. Other areas are in permanent grass and idle. Limitations are severe for most nonfarm uses. Capability unit IIw–1(L–2c); woodland suitability group 2o4; woody plant group 2.

Sims Series

The Sims series consists of nearly level, very poorly drained and poorly drained soils in depressions and on broad flats of till plains and moraines. These soils formed in calcareous loamy glacial till.

In a representative profile the surface layer is a very dark gray and gray light silty clay loam about 14 inches thick. The upper 10 inches of the subsoil is gray clay loam. The middle 12 inches is gray light clay loam. The lower 4 inches is gray silty clay loam. The underlying material at a depth of 40 inches is gray silty clay loam.

Runoff is very slow to ponded. Permeability is slow. Available water capacity is high.

Sims soils are well suited to farming if they are adequately drained. They are severely limited for most nonfarm uses.

Representative profile of Sims silty clay loam in a cultivated area 800 feet east and 850 feet north of the southwest corner of 12 T. 7 N., R. 4 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) light silty clay loam; weak medium granular structure; firm; 3 percent pebbles; abrupt smooth boundary.

A12—9 to 14 inches; gray (10YR 5/1) light silty clay loam; few fine distinct yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; firm; 3 percent pebbles; neutral; clear wavy boundary.

B21g—14 to 24 inches; gray (10YR 6/1) clay loam; fine distinct yellowish brown mottles (10YR 5/6) and few fine faint gray (10YR 5/1) mottles; weak medium angular blocky structure; friable; 5 percent pebbles; neutral; clear wavy boundary.

B22g—24 to 36 inches; gray (10YR 5/1) light clay loam; many coarse distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; 5 percent pebbles; neutral; clear wavy boundary.

B3g—36 to 40 inches; gray (10YR 6/1) silty clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; massive; 5 percent pebbles; clear wavy boundary.

Cg—40 to 60 inches; gray (10YR 6/1) silty clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; 5 percent pebbles; mildly alkaline; slight effervescence.

The solum is 20 to 40 inches thick. Pebble content throughout the profile ranges from 1 to 8 percent. Reaction is generally neutral or mildly alkaline, but is slightly acid in places.

The Ap horizon is very dark gray (10YR 3/1), black (10YR 2/1), or very dark brown (10YR 2/2) light silty clay loam or light clay loam. The A12 horizon is not present in all places. In undisturbed areas the A1 horizon is black (10YR 2/1) or very dark gray (10YR 3/1) and is 5 to 9 inches thick.

The B horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 and 2. It is clay loam, silty clay loam, or light silty clay. Clay content ranges from 35 to 45 percent. The C horizon is clay loam or silty clay loam.

The mean annual soil temperature in this county is outside the stated range for the series, but this difference does not alter use and management.

Sims soils in most landscapes are near Parkhill, Blount, and Corunna soils. They are finer textured in the solum than Parkhill or Corunna soils. They have gray colors in the Solum, whereas Blount soils have brown colors. They differ from Blount soils in having a dark colored surface layer.

Sm—Sims silty clay loam. This nearly level soil is on low till plains, in old lake beds and drainageways, and on depressed uplands. Individual areas range from about 5 to 100 acres or more in size. Most areas are irregular in shape. Slopes are 0 to 2 percent. Included in mapping are small areas of Parkhill and Colwood soils and small areas of soils that have more clay throughout the profile.

Wetness is the main limitation. Most areas are farmed, and the soil is well suited to this use if adequately drained. Surface drainage must be provided in addition to subsurface drainage. Drained areas are in corn, sugar beets, beans, wheat, oats, and forage crops. Undrained areas are used for pasture or remain wooded with slow growing, poor quality, lowland hardwoods. Many of these woodlots are pastured. Limitations are severe for most nonfarm uses. Capability unit IIw–1(1.5c); woodland suitability group 2w1; woody plant group 2.

Sisson Series

The Sisson series consists of gently sloping, well drained soils on outwash plains and on lake plains. These soils formed in loamy lacustrine deposits.

In a representative profile the surface layer is dark grayish brown fine sandy loam 8 inches thick. The subsurface layer is light yellowish brown fine sandy loam 7 inches thick. The upper 8 inches of the subsoil is yellowish brown, friable fine sandy loam. The lower 15 inches is dark brown firm light silty clay loam. The upper 4 inches of the underlying material is yellowish brown silt loam. The underlying calcareous material beginning at a depth of 42 inches is brown stratified silt, fine sand, and very fine sand.

Runoff is medium. Permeability is moderate. Available water capacity is high.

Sisson soils are well suited to farming. They are slightly to severely limited for nonfarm uses.

Representative profile of Sisson fine sandy loam, 2 to 6 percent slopes, in a cultivated field 1,960 feet south and 640 feet east of northwest corner of sec. 29, T. 5 N., R. 2 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) fine sandy loam; weak medium granular structure; very friable; many roots; neutral; abrupt smooth boundary.

A2—8 to 15 inches; light yellowish brown (10YR 6/4) fine sandy loam; weak fine granular structure; very friable; many roots; slightly acid; clear wavy boundary.

B1—15 to 23 inches; yellowish brown (10YR 5/4) fine sandy loam; moderate fine subangular blocky structure; friable; many roots; slightly acid; abrupt smooth boundary.

B2t—23 to 38 inches; dark brown (7.5YR 4/4) light silty clay loam; moderate fine subangular blocky structure; firm; few clay films; many light yellowish brown (10YR 6/4) silt coatings; slightly acid; abrupt smooth boundary.

C1—38 to 42 inches; yellowish brown (10YR 5/4) silt loam; weak thin platy structure; friable; slight effervescence; mildly alkaline; clear smooth boundary.

C2—42 to 60 inches; brown (10YR 5/3) stratified silt, fine sand, and very fine sand; massive; friable; few lime coatings; strong effervescence; moderately alkaline.

The solum is 30 to 42 inches thick. Reaction below the Ap horizon is slightly acid to mildly alkaline.

The Ap horizon is dark grayish brown (10YR 4/2), brown (10YR 5/3), or dark brown (10YR 4/3). Where present, the A2 horizon is light yellowish brown (10YR 6/4), pale brown (10YR 6/3), or brown (10YR 5/3).

The B horizon is yellowish brown (10YR 5/4, 5/6), dark brown (7.5YR 4/4), or dark yellowish brown (10YR 4/4) fine sandy loam, silt loam, and light silty clay loam. The thickness and sequence of layers vary because of stratification. The B2t horizon is dominantly light silty clay loam or heavy silt loam.

The C horizon is stratified silt, fine sand, and very fine sand. There are a few 1-3 inch lenses of silty clay loam or silty clay. This horizon is strongly effervescent or violently effervescent.

Sisson soils in most landscapes are near Kibbie and Lapeer soils. They lack the grayish brown mottles throughout the subsoil that are characteristic of Kibbie soils. They have a finer textured subsoil and underlying material than Lapeer soils.

SnB—Sisson fine sandy loam, 2 to 6 percent slopes. This gently sloping soil is on smooth upper side slopes, interdrainage divides, and on short side slopes bordering well defined drainage channels. Individual areas range from 3 to about 20 acres in size. They are irregular in shape.

Included with this soil in mapping are some small areas of Kibbie and Colwood soils in depressions and drainageways. Small wet spots of less than 3 acres are identified by spot symbols on the soil map.

Erosion is the main problem. This soil is well suited to farming. Corn, beans, wheat, oats, and legume-grass hay are the chief crops. Limitations are slight to severe for nonfarm uses. Capability unit IIe–2 (2.5a–s); woodland suitability group 1o1; woody plant group 3.

Sloan Series

The Sloan series consists of nearly level, very poorly drained soils on flood plains. These soils formed in loamy alluvium.

In a representative profile the surface layer is very dark gray loam 10 inches thick. The subsoil is friable, gray, mottled silt loam 30 inches thick. The underlying material at a depth of 40 inches is stratified gray silt loam, light silty clay loam, and sandy loam.

Runoff is very slow to ponded. Permeability is moderate. Available water capacity is high.

Sloan soils are moderately well suited to farming if they are artificially drained and protected from seasonal flooding. Many areas are wooded or in brush and grass vegetation. The soils are severely limited for most nonfarm uses.

Representative profile of Sloan loam in a wooded area 90 feet south and 120 feet west of the northeast corner of sec. 15, T. 8 N., R. 4 W.

A1—0 to 10 inches; very dark gray (10YR 3/1) loam; moderate medium granular structure; friable; neutral; abrupt smooth boundary.

B1g—10 to 18 inches; gray (10YR 5/1) silt loam; common fine faint brown (10YR 5/3) mottles and few fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; neutral; abrupt wavy boundary.

B21g—18 to 31 inches; gray (10YR 6/1) silt loam; many coarse distinct dark gray (10YR 4/1) mottles and many coarse distinct yellowish brown (10YR 5/6) mottles; weak medium angular blocky structure; friable; dark gray colors are traces of organic matter; very thin, less than 1 inch, strata of silty clay loam; neutral; clear wavy boundary.

B22g—31 to 40 inches; gray (10YR 6/1) silt loam; common medium distinct dark gray (10YR 4/1) mottles and many medium distinct yellowish brown (10YR 5/6) mottles; weak medium angular blocky structure; friable; dark gray colors are accumulations of organic matter; neutral; clear wavy boundary.

Cg—40 to 60 inches; gray (10YR 5/1) stratified silt loam, light silty clay loam, and sandy loam; many medium distinct yellowish brown (10YR 5/6) mottles and few fine faint dark gray (10YR 4/1) mottles; massive; friable; dark gray material is organic matter; slight effervescence; mildly alkaline.

The solum is 30 to 45 inches thick. Organic accumulations are irregular throughout the B horizon and upper part of the C horizon. Reaction throughout the solum is neutral or mildly alkaline.

The A horizon is very dark gray (10YR 3/1), black (10YR 2/1), or very dark brown (10YR 2/2). There is an A12 horizon in some places.

The B horizon is gray (10YR 6/1, 5/1), dark gray (10YR 4/1), grayish brown (10YR 5/2), or dark grayish brown (10YR 4/2) loam or loam that has thin strata of silty clay loam, sand, loamy sand, or sandy loam.

The C horizon has thin layers of sand, loamy sand, sandy loam, loam, silt loam, or silty clay loam.

Sloan soils in most landscapes are near Shoals and Cohoctah soils. They have grayer colors in the subsoil than Shoals soils, and are finer textured throughout the solum than Cohoctah soils.

So—Sloan loam. This nearly level soil is on first bottoms on the flood plains. Individual areas range from 5 to 120 acres in size. Slopes are 0 to 2 percent. Included in mapping are small areas of Shoals and Cohoctah soils and small ponded areas in some places.

Wetness and seasonal flooding are the main problems. Most areas are wooded or in permanent grass. A few are used for permanent pasture. If artificially drained, the soil is used for such row crops as corn and soybeans. Limitations are severe for nonfarm uses. Capability unit IIIw–2 (L–2c); woodland suitability group 2w1; woody plant group 2.

Spinks Series

The Spinks series consists of nearly level to sloping,

well drained soils on moraines, outwash plains, stream terraces, and old glacial beach ridges.

In a representative profile the surface layer is dark brown loamy sand 8 inches thick. The upper 11 inches of the subsoil is yellowish brown, loose sand. The lower 35 inches is brown, loose sand that has bands of strong brown, very friable sandy loam (fig. 7). The underlying material at a depth of 54 inches is pale brown sand.

Runoff is very slow to medium. Permeability is rapid and moderately rapid. Available water capacity is low.

Spinks soils are moderately suited to farming if droughtiness, the erosion hazard, and low natural fertility can be overcome. Many areas have been cleared and cultivated. Others are idle, pastured, or wooded.

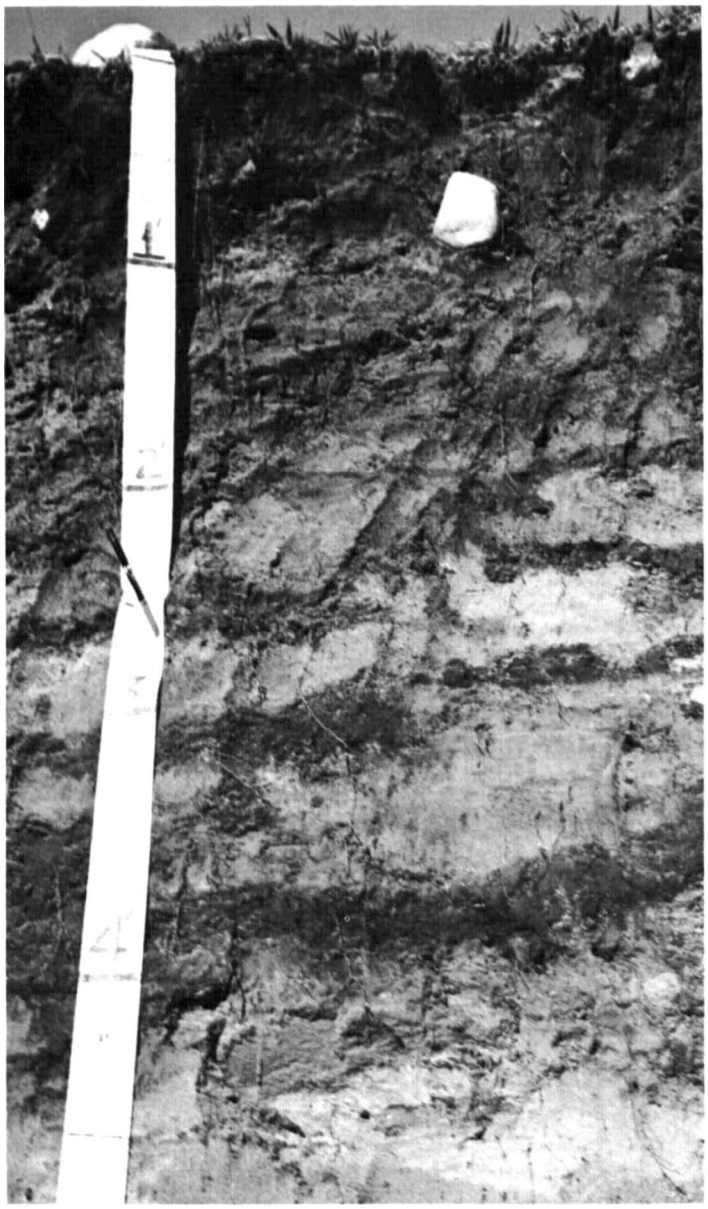


Figure 7.—**Profile of Spinks loamy sand showing the characteristic banding in the lower part of the subsoil.**

The soils are slightly to moderately limited for most nonfarm uses.

Representative profile of Spinks loamy sand, 0 to 6 percent slopes, in an idle field 2,310 feet east and 544 feet south of the northwest corner of sec. 26, T. 5 N., R. 1 W.

Ap—0 to 8 inches; dark brown to brown (10YR 4/3) loamy sand; weak medium granular structure; very friable; many roots; 2 percent pebbles; medium acid; abrupt wavy boundary.

A2—8 to 19 inches; dark yellowish brown (10YR 5/4) sand; single grained; loose; common roots; 2 percent pebbles; slightly acid; clear wavy boundary.

A2&Bt—19 to 31 inches; pale brown (10YR 6/3) sand (A2 part); single grained; loose; bands of strong brown (7.5YR 5/6) sandy loam (Bt part); weak medium subangular blocky structure; very friable; few fine roots; textural bands are ¼ to 1 inch thick and spaced 1 to 4 inches apart; few thin clay coatings; 2 percent pebbles; slightly acid; clear irregular boundary.

Bt&A2—31 to 39 inches; strong brown (7.5YR 5/6) sandy loam (Bt part); weak medium subangular blocky structure; very friable; textural bands are 2 to 4 inches thick and spaced ¼ to 1 inch apart; few thin clay films. Brown (10YR 5/3) sand (A2 part); single grained; loose; few fine roots; 2 percent pebbles; slightly acid; clear irregular boundary.

A2&Bt—39 to 54 inches; brown (10YR 5/3) sand (A2 part); single grained; loose. Bands of strong brown (7.5YR 5/6) loamy sand (Bt part); weak fine subangular blocky structure; very friable; bands are ¼ to 2 inches thick and spaced 1 to 5 inches apart; few thin clay coatings; 2 percent pebbles; neutral; gradual irregular boundary.

C—54 to 60 inches; pale brown (10YR 6/3) sand; single grained; loose; 5 percent pebbles; slight effervescence; moderately alkaline.

The solum is from 43 inches to 60 inches or more thick. Pebble content ranges from 0 to 15 percent. Reaction ranges from medium acid to neutral.

The Ap horizon is dark grayish brown (10YR 4/2), brown (10YR 4/3, 5/3), or grayish brown (10YR 5/2). Where the A horizon is very dark grayish brown (10YR 3/2) or dark brown (10YR 3/3), the dry color is light brownish gray (10YR 6/2) or light gray (10YR 7/2).

The A2 horizon is dark yellowish brown (10YR 4/4), yellowish brown (10YR 5/4, 5/6), light yellowish brown (10YR 6/4), or brownish yellow (10YR 6/6) sand or loamy sand. The A2 part of the A2&Bt and Bt&A2 horizons is brown (10YR 5/3), pale brown (10YR 6/3), yellowish brown (10YR 5/4, 5/6), and light yellowish brown (10YR 6/4) sand or loamy sand. The Bt part of the A2&Bt and Bt&A2 horizons is yellowish brown (10YR 5/4), dark brown (7.5YR 4/4), dark yellowish brown (10YR 4/4), or strong brown (7.5YR 5/6). Individual bands are loamy sand or sandy loam.

The C horizon ranges from neutral to moderately alkaline.

Spinks soils in most landscapes are near Boyer, Oakville, and Thetford soils and the Spinks variant soils. They differ from Boyer soils in having a thicker solum and no gravelly underlying material. They differ from Oakville soils in having bands of loamy sand and sandy loam in the subsoil. They do not have the mottles in the subsoil that are characteristic of Thetford soils. They do not have the pebbles and cobblestones throughout the profile that are characteristic of the Spinks variant.

SpB—Spinks loamy sand, 0 to 6 percent slopes. This nearly level and gently sloping soil is on broad plains and ridgetops and on benches bordering rivers and streams. Individual areas range from about 5 to 100 acres or more in size. The large areas on the plains are long and irregular in shape. This soil has the profile described as representative of the series.

Included with this soil in mapping are some small eroded areas and areas where loamy material is below

a depth of 40 inches. Small wet spots less than 3 acres in size are identified by spot symbols on the soil map.

Low available water capacity and the hazard of soil blowing are problems. Most areas have been cleared and cultivated. Many are now idle. A few areas are pastured. Others are wooded with mixed upland hardwoods. This soil is moderately suited to such crops as corn, beans, wheat, oats, and legume-grass hay. Limitations are slight for most nonfarm uses. Capability unit IIIs–1(4a); woodland suitability group 2s5; woody plant group 3.

SpC—Spinks loamy sand, 6 to 12 percent slopes. This sloping soil is in areas bordering drainageways and on ridges and moraines. Areas bordering drainageways are long and uniform and range from 5 to 60 acres. Narrow ridges are long and irregular and are generally less than 20 acres in size. Areas on moraines range from 5 to 20 acres in size and are irregular in shape. This soil has a profile similar to the one described as representative of the series, but it is shallower over the underlying sandy material and has a surface layer of grayish brown loamy sand.

Included with this soil in mapping are small eroded areas and small areas of soils that have thin layers of very fine sand and silt in the underlying material. Small wet spots less than 3 acres in size are identified by spot symbols on the soil map.

Low available water capacity and the hazard of soil blowing are problems. Most areas of this soil are idle or pastured. A few areas are cultivated. Others remain wooded. This soil is only moderately suited for such commonly grown crops as small grains and legume-grass hay. Limitations are moderate for most nonfarm uses. Capability unit IIIe–4(4a); woodland suitability group 2s5; woody plant group 3.

Spinks Variant

The Spinks variant consists of nearly level and gently sloping, well drained soils on outwash plains and old, high terraces. These soils formed in cobbly, sandy, and loamy glaciofluvial deposits.

In a representative profile the surface layer is very dark grayish brown and dark brown cobbly loamy sand 7 inches thick. The upper 17 inches of the subsoil is dark brown, very friable cobbly loamy sand. The lower 24 inches is yellowish brown, loose cobbly sand that has bands of dark brown, friable sandy loam. The underlying material, at a depth of 48 inches, is light yellowish brown cobbly sand.

Runoff is slow. Permeability is rapid. Available water capacity is low. Some areas of Spinks variant have been cleared but are now idle and are covered with grass-brush vegetation. A few areas remain wooded. These soils are poorly suited to farming because of cobbles, stones, droughtiness, and low natural fertility. They are moderately to severely limited for most nonfarm uses.

Representative profile of Spinks cobbly loamy sand, cobbly variant, 0 to 6 percent slopes, in an idle field 2,180 feet west and 625 feet north of southeast corner of sec. 10, T. 8 N., R. 1 W.

A11—0 to 5 inches; very dark grayish brown (10YR 3/2) cobbly loamy sand; weak medium granular structure; very friable; many fine roots; 50 percent pebbles and cobblestones; neutral; clear irregular boundary.

A12—5 to 7 inches; dark brown (7.5YR 4/2) cobbly loamy sand; weak medium subangular blocky structure; very friable; many fine roots; 50 percent pebbles and cobblestones; neutral; clear irregular boundary.

B1—7 to 24 inches; dark brown (7.5YR 4/4) cobbly loamy sand; weak medium subangular blocky structure; very friable; few roots; 60 percent pebbles and cobblestones; slightly acid; clear irregular boundary.

A2&Bt—24 to 48 inches; yellowish brown (10YR 5/6) cobbly sand (A2 part); single grained; loose; bands of dark brown (7.5YR 4/4) sandy loam (Bt part); moderate medium subangular blocky structure; friable; few clay films; 60 percent pebbles and cobblestones; neutral; clear irregular boundary.

C—48 to 60 inches; light yellowish brown (10YR 6/4) cobbly sand; single grained; loose; 40 percent pebbles and cobblestones; mildly alkaline; slight effervescence.

The solum is 40 to 60 inches or more thick. Reaction throughout the solum ranges from medium acid to mildly alkaline. Pebbles and cobblestones range from 35 percent to more than 60 percent throughout the profile. Coarse fragments are about 30 percent stones, 65 percent cobbles, and 5 percent pebbles.

The A1 horizon is very dark grayish brown (10YR 3/2), very dark gray (10YR 3/1), dark brown (10YR 3/3, 4/3), brown (10YR 5/3), or dark grayish brown (10YR 4/2). The A1 horizon is light brownish gray (10YR 6/2) or light gray (10YR 7/2) dry. The A12 horizon is dark grayish brown (10YR 4/2) or dark brown (10YR 4/3).

The B1 horizon is dark brown (7.5YR 4/4), brown (7.5YR 5/4 or 10YR 5/3), yellowish brown (10YR 5/4, 5/6), or strong brown (10YR 5/6) loamy sand or sand. The A2 part of the A2&Bt horizon is strong brown (7.5YR 5/6), yellowish brown (10YR 5/4, 5/6), pale brown (10YR 6/3), or light yellowish brown (10YR 6/4) sand or loamy sand.

The Bt part of the A2&Bt horizon is dark brown (7.5YR 4/4), brown (7.5YR 5/4), dark yellowish brown (10YR 4/4), or yellowish brown (10YR 5/4) loamy sand or sandy loam. The bands are ¼ to 5 inches thick, are spaced 2 to 10 inches apart, and have an accumulative thickness of more than 6 inches.

The C horizon is light yellowish brown (10YR 6/4), pale brown (10YR 6/3), yellowish brown (10YR 5/4, 5/6), or strong brown (7.5YR 5/6).

The Spinks variant and Spinks soils formed in similar material. The variant has a higher content of coarse fragments than Spinks soils.

StB—Spinks cobbly loamy sand, cobbly variant, 0 to 6 percent slopes. This nearly level and gently sloping soil is on outwash plains and terraces of old glacial drainageways. Individual areas range from 5 to 80 acres in size. They are long and narrow.

Included with this soil in mapping are small areas of Thetford soils in depressions. Wet spots less than 3 acres in size are identified by spot symbols on the soil map.

The presence of cobbles and stones, the droughtiness, and the low natural fertility are limitations (fig. 8) of this soil for farming. Nearly all areas of this soil are idle. A few are wooded. Because of the cobbles and stones in the surface layer, tillage is impractical. Limitations are moderate to severe for most nonfarm uses. Capability unit Vs–1(4a); woodland suitability group 2s8; woody plant group 3.

Thetford Series

The Thetford series consists of nearly level to gently sloping, somewhat poorly drained soils on outwash plains, moraines, till plains, and terraces.

Figure 8.—**Exposed bank of Spinks variant. Coarse fragments dominate the soil profile.**

In a representative profile the surface layer is very dark gray loamy sand 9 inches thick. The upper 5 inches of the subsoil is yellowish brown, very friable, mottled loamy sand. The next 7 inches is pale brown, mottled loamy sand. The next 7 inches is a mixture of dark yellowish brown, friable, heavy loamy sand and brown, very friable, mottled loamy sand. The lower 6 inches of the subsoil is grayish brown and strong brown, friable sandy loam. The underlying material at a depth of 34 inches is pale brown, mottled sand.

Runoff is slow. Permeability is moderately rapid. Available water capacity is low.

Thetford soils are moderately suited to farming if wetness can be overcome. They are severely limited for most nonfarm uses.

Representative profile of Thetford loamy sand, 0 to 3 percent slopes, in a cultivated field 2,440 feet east of the center of sec. 2, T. 8 N., R. 1 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) loamy sand; weak fine granular structure; very friable; many fine roots; slightly acid; abrupt smooth boundary.

B1—9 to 14 inches; yellowish brown (10YR 5/4) loamy sand; few fine faint brownish yellow (10YR 6/6) mottles; weak coarse subangular blocky structure; very friable; few fine distinct dark grayish brown worm casts, slightly acid; clear irregular boundary.

A'2—14 to 21 inches; pale brown (10YR 6/3) loamy sand; few fine faint brownish yellow (10YR 6/6) mottles; weak thick platy structure; very friable; weak fragipan structural development; few fine shotlike dark brown (10YR 3/3) concretions; friable to slightly brittle; medium acid; clear irregular boundary.

B'21t&A'22—21 to 28 inches. B part—dark yellowish brown (10YR 4/4) heavy loamy sand; common medium yellowish brown mottles and many medium pale brown mottles; weak medium subangular blocky structure; friable; horizons are from ¼ to 2 inches thick; medium acid; clear irregular boundary. A part—brown (10YR 5/3) loamy sand; few fine faint dark brown (10YR 3/3) mottles; weak coarse subangular blocky structure; very friable; medium acid; clear irregular boundary.

B'22tg—28 to 34 inches; grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) sandy loam; weak coarse subangular blocky structure; friable; colors are about equal in proportion and distribution; 2 percent pebbles; slightly acid; clear wavy boundary.

C—34 to 60 inches; pale brown (10YR 6/3) sand; few medium faint light brownish gray (10YR 6/2) and yellowish brown (10YR 5/6) mottles; loose; ¼ to 1 inch yellowish brown color bands; 5 percent pebbles; neutral.

The solum is 30 to 60 inches thick. Reaction is medium acid to mildly alkaline.

The Ap horizon is very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), or dark brown (10YR 3/3). In places there is an A2 horizon of brown (10YR 5/3) loamy sand 1 to 6 inches thick.

The A'2 part of the A'2 & B't horizon is mottled, pale brown (10YR 6/3), brown (10YR 5/3), very pale brown (10YR 7/4 or 7/4), or light yellowish brown (10YR 6/4) loamy sand or sand. The B part of the A'2 & B't horizon is mottled dark yellowish brown (10YR 4/4), yellowish brown (10YR 5/4), or brown (10YR 5/3) loamy sand or sandy loam. Thickness of the discontinuous loamy sand and sandy loam bands in the B part is ¼ to 3 inches. The A'2 and B't occur as separate horizons in some places.

The C horizon is pale brown (10YR 6/3), grayish brown (10YR 5/2), gray (10YR 5/1), light brownish gray (10YR 6/2), or light yellowish brown (10YR 6/4).

Thetford soils in most landscapes are near Spinks and Selfridge soils. They have mottles in the subsoil, whereas Spinks soils do not. They do not have the underlying loamy material characteristic of Selfridge soils.

ThA—Thetford loamy sand, 0 to 3 percent slopes. This nearly level and gently sloping soil occupies terraces on broad plains and depressions and foot slopes of the uplands. Individual areas on the plains are about 5 to 40 acres and irregular in shape. On stream terraces, in depressions, and on foot slopes, they are long and 5 to 20 acres. Included in mapping are small areas of Granby and Gilford soils in minor depressions and drainageways.

Seasonal wetness is the main limitation. Some areas have been drained and cultivated. Others are idle or pastured. A few areas remain wooded with mixed

hardwoods. Drained areas are suited to such crops as field beans, soybeans, wheat, oats, and legume-grass hay. Limitations are severe for most nonfarm uses. Capability unit IIIw–1(4b); woodland suitability group 3s3; woody plant group 2.

Wallkill Series

This series consists of nearly level, very poorly drained soils in depressional areas in moraines and on till plains and flood plains. These soils formed in loamy mineral alluvium over organic material.

In a representative profile the surface layer is very dark brown loam 5 inches thick. The subsoil is very dark brown, friable silt loam 14 inches thick. The upper 18 inches of the underlying material is black muck. The lower 37 inches is dark yellowish brown mucky peat.

Runoff is very slow to ponded. Permeability is moderate in the mineral material and moderately slow to moderately rapid in the organic material. Available water capacity is very high.

Many areas are wooded or in permanent grass. A few areas are used for hay, pasture, and crops. If adequately drained, these soils are moderately well suited to farming. They are severely limited for most nonfarm uses.

Representative profile of Wallkill loam in an idle area 1,000 feet north and 100 feet west of the center of sec. 20, T. 5 N., R. 1 W.

A1—0 to 5 inches; very dark brown (10YR 2/2) loam; moderate fine granular structure; friable; 2 percent pebbles; medium acid; gradual wavy boundary.

Bg—5 to 19 inches; very dark brown (10YR 2/2) silt loam; moderate fine subangular blocky structure; many fine roots; friable; 5 percent pebbles; medium acid; abrupt smooth boundary.

II0a—19 to 37 inches; black (10YR 2/1) well decomposed, sapric material; moderate medium granular structure; friable; less than 10 percent rubbed fibers; slightly acid; clear smooth boundary.

II0e—37 to 60 inches; dark yellowish brown (10YR 3/4) hemic material; massive; nonsticky; 25 to 30 percent rubbed fibers; slightly acid.

The mineral soil that overlies the organic material is 16 to 40 inches thick. It consists of an A1 or Ap horizon and a weakly expressed structural Bg horizon or a Cg horizon, or both.

The organic layer below the mineral soil is at least 20 inches thick. The Ap horizon ranges in color from black (10YR 2/1), very dark brown (10YR 2/2), to dark grayish brown (2.5Y 4/2). It is dominantly loam, but ranges from sandy loam to clay loam.

The B horizon ranges in color from gray (5Y 5/1), dark gray (5YR 4/1), very dark brown (10YR 2/2), to grayish brown (10YR 5/2). It is dominantly loam or silt loam, but ranges from sandy loam to clay loam. The B horizon is weakly expressed in most places, or is replaced by a Cg horizon. The underlying organic material is hemic or sapric and includes woody material or herbaceous material, or both.

Wallkill soils are formed in the same kind of materials as Washtenaw soils. They are underlain by organic material, whereas Washtenaw soils are underlain by mineral material.

Wa—Wallkill loam. This nearly level soil is in depressions of the uplands, at the outer edge of the flood plains, and at the edges of organic material where these soils merge with mineral material of the uplands. Individual areas range from 2 to about 10 acres in size. At the margins of the flood plains and organic deposits they are long and narrow. In the upland depressions they are oval. Included in mapping are small areas of Washtenaw soils near adjacent slopes and spots of Houghton and Palms soils.

Wetness is the main limitation. Drainage is necessary for most crops. Adequate outlets for drainage water are a problem in many areas. Most areas are idle or wooded. A few are cultivated or pastured. If adequately drained, corn and such special crops as vegetables and grass sod can be grown. Limitations are severe for most nonfarm uses. Capability unit IIIw–2(L-2c); woodland suitability group 4w2; woody plant group 1.

Wasepi Series

The Wasepi series consists of nearly level and gently sloping, somewhat poorly drained soils on terraces, on outwash plains, and in drainageways. These soils formed in loamy glaciofluvial deposits.

In a representative profile the surface layer is very dark grayish brown sandy loam 8 inches thick. The subsurface layer is brown sandy loam 3 inches thick. The upper 4 inches of the subsoil is dark yellowish brown, very friable, light sandy loam. The middle 18 inches is yellowish brown and dark yellowish brown, firm and friable, mottled heavy sandy loam. The lower 4 inches is yellowish brown loose sand. The underlying material at a depth of 37 inches is grayish brown, stratified sand and gravel.

Runoff is slow. Permeability is moderately rapid. Available water capacity is low.

Most areas of Wasepi soils are used for crops. A few areas are pastured, idle, or wooded. The soils are moderately well suited to farming. They are severely limited for most nonfarm uses.

Representative profile of Wasepi sandy loam, 0 to 3 percent slopes, in an idle field 780 feet south and 70 feet east of northwest corner of sec. 5, T. 5 N., R. 1 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) sandy loam; grayish brown (10YR 5/2) dry; weak fine granular structure; friable; many roots; 10 percent pebbles; slightly acid; abrupt smooth boundary.

A2—8 to 11 inches; brown (10YR 5/3) sandy loam; weak thin platy structure; friable; many roots; 10 percent pebbles; slightly acid; clear wavy boundary.

B1—11 to 15 inches; dark yellowish brown (10YR 4/4) light sandy loam; common medium faint brown (10YR 5/3) mottles; weak medium subangular blocky structure; very friable; few roots; 10 percent pebbles; slightly acid; clear wavy boundary.

B21t—15 to 26 inches; yellowish brown (10YR 5/6) sandy loam; common medium distinct grayish brown (10YR 5/2) and dark brown (7.5YR 4/4) mottles; weak medium subangular blocky structure; friable; few clay films; 10 percent pebbles; slightly acid; abrupt wavy boundary.

B22t—26 to 33 inches; dark yellowish brown (10YR 4/4) heavy sandy loam; many coarse distinct grayish brown (10YR 5/2) mottles; moderate fine subangular blocky structure; firm; few clay films; 10 percent pebbles; slightly acid; abrupt wavy boundary.

IIB3—33 to 37 inches; yellowish brown (10YR 5/4) sand; common medium distinct light brownish gray (10YR 6/2) and yellowish brown (10YR 5/8) mottles; single grained; loose; 10 percent pebbles; neutral; clear wavy boundary.

IICg—37 to 60 inches; grayish brown (2.5Y 5/2) stratified sand and gravel; single grained; loose; 60 percent pebbles; mildly alkaline; slight effervescence.

Thickness of the solum is 28 to 40 inches. Pebble content

in the solum ranges from 0 to 25 percent. Reaction is slightly acid or neutral.

The Ap horizon is very dark grayish brown (10YR 3/2) or very dark brown (10YR 2/2). The A2 horizon is brown (10YR 5/3) or pale brown (10YR 6/3) sandy loam or loamy sand.

The B horizon is dark yellowish brown (10YR 4/4), yellowish brown (10YR 5/6), or strong brown (7.5YR 5/6). The B1 horizon is sandy loam or loamy sand. The B21t and B22t horizons are sandy loam or light sandy clay loam. The IIB3 horizon, where present, is sand or loamy sand. The IIC horizon is dominantly sand or gravel but ranges to stratified sand and gravel.

Wasepi soils in most landscapes are near Gilford and Matherton soils. They have a yellowish brown subsoil, whereas Gilford soils have a gray subsoil. Wasepi soils have a coarser textured subsoil than Matherton soils.

WbA—Wasepi sandy loam, 0 to 3 percent slopes. This nearly level and gently sloping soil is on broad outwash plains, on low terraces, and in drainageways. Most areas range from 5 to 40 acres or more. They are irregular in shape. A few areas along drainageways are long and narrow. Included in mapping are small areas of sloping Boyer soils and small areas of Gilford soils in drainageways and depressions.

Wetness is the main limitation. Most areas have been cleared and farmed. If adequately drained, this soil is suited to such crops as corn, field beans, soybeans, wheat, oats, and grass-legume hay. Undrained areas are pastured or idle. A few areas remain wooded. Limitations are severe for most nonfarm uses. Capability unit IIIw–1(4b); woodland suitability group 3s3; woody plant group 2.

Washtenaw Series

The Washtenaw series consists of nearly level, very poorly drained and poorly drained soils in depressed areas in moraines and on till plains and outwash plains. These soils formed in loamy overwash material over loamy glacial till.

In a representative profile the surface layer is dark grayish brown loam 10 inches thick. The underlying material is dark grayish brown loam 15 inches thick. The buried surface layer is very dark brown loam 4 inches thick. The buried subsoil is gray, firm clay loam 8 inches thick. The underlying material at a depth of 37 inches is gray loam.

Runoff is very slow to ponded. Permeability is slow and moderately slow. Available water capacity is high.

Most areas of this soil are wooded or are in native grasses. A few areas are used for pasture or crops. If artificially drained, these soils are well suited for farming. They are severely limited for most nonfarm uses.

Representative profile of Washtenaw loam in an idle area 610 feet south and 1,170 feet west of northeast corner of sec. 2, T. 5 N., R. 1 W.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) loam; weak fine granular structure; friable; 2 percent pebbles; neutral; abrupt smooth boundary.

C1g—10 to 25 inches; dark grayish brown (10YR 4/2) loam; common fine faint light brownish gray (10YR 6/2) mottles and common distinct yellowish brown (10YR 5/8) mottles; massive; friable; 2 percent pebbles; neutral; clear wavy boundary.

IIA1b—25 to 29 inches; very dark brown (10YR 2/2) loam; weak fine granular structure; firm; 2 percent pebbles; slightly acid; abrupt wavy boundary.

IIB21tgb—29 to 31 inches; dark gray (10YR 4/1) clay loam; few fine distinct light brownish gray (10YR 6/2) mottles and common fine faint dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; firm; few thin continuous clay films; 5 percent pebbles; neutral; clear wavy boundary.

IIB22tgb—31 to 37 inches; gray (10YR 6/1) clay loam; common fine distinct yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; firm common thin continuous clay films; 5 percent pebbles; neutral; clear wavy boundary.

IIC2g—37 to 60 inches; gray (10YR 6/1) loam; common distinct light yellowish brown (10YR 6/4) mottles and brownish yellow (10YR 6/8) mottles; weak medium subangular blocky structure; firm; 5 percent pebbles; mildly alkaline; slight effervescence.

Thickness of the overwash material typically is 20 to 30 inches but ranges to 40 inches. Pebble content throughout the profile ranges from 1 to 10 percent.

The Ap horizon is dark grayish brown (10YR 4/2), dark brown (10YR 4/3), or dark yellowish brown (10YR 3/4). The C1g horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or light brownish gray (10YR 6/2) loam or silt loam.

The IIA1b horizon is very dark brown (10YR 2/2), black (10YR 2/1), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). The IIB21tgb and IIB22tgb horizons are dark gray (10YR 4/1), gray (10YR 5/1, 6/1), grayish brown (10YR 5/2), or light brownish gray (10YR 6/2) loam or clay loam.

The IICg horizon is dominantly loam, but is stratified in some profiles.

Washtenaw soils and Wallkill soils formed in similar material. Washtenaw soils are underlain by mineral material, whereas Wallkill soils are underlain by organic material.

Wd—Washtenaw loam. This nearly level soil is in dish-shaped depressions, in waterways, and on toe slopes in the uplands. Individual areas range from 3 to about 15 acres. The depressions are round. Areas on toe slopes and in waterways are long and narrow.

Wetness and ponding are the main problems. Many areas are difficult to drain because they lack outlets. These undrained areas are in native grass, willows, and marsh type vegetation. If adequately drained, this soil is suited to such crops as corn, beans, wheat, oats, and grass-legume hay. Limitations are severe for nonfarm uses. Capability unit IIw–1(L-2c); woodland suitability group 2w1; woody plant group 2.

Use and Management of the Soils

The following pages define general principles of management that apply to all soils used for farming in Clinton County. They also explain the capability classification used by the Soil Conservation Service. Estimated yields per acre of the principal crops under a high level of management are listed in table 2. Also on the pages that follow is information on woodland, wildlife habitat, recreational development, engineering, and selected uses of soils to be considered in town and country planning.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth,

or other characteristics of the soils. It does not take into consideration possible but unlikely major reclamation projects and it does not apply to mint, horticultural crops, or other crops that require special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for wildlife, for forest trees, or for engineering.

In the capability system, all soils are grouped at three levels: the capability class, subclass, and unit. These levels are described in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife habitat.

Class VI soils have severe limitations that make them generally unsuitable for cultivated crops and limit their use largely to pasture, range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuitable for cultivated crops and restrict their use largely to pasture, range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife habitat, or water supply or to esthetic purposes. (No Class VIII soils in Clinton County.)

CAPABILITY SUBCLASSES are soil groups within one class. They are designated by adding a small letter, *e*, *w*, or *s*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage) ; *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the country, relates to climate.

There are no subclasses in Class I because these soils have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because these soils are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, woodland, wildlife habitat, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–2 or IIIe–4. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

The capability classification of the soils in Clinton County is given at the end of the mapping unit in the section "Descriptions of the Soils." For a complete explanation of the capability classification system, see Agriculture Handbook No. 210, Land Capability Classification (*6*).

Management by Capability Units [2]

An adequate supply of plant nutrients and organic matter, a good depth in the root zone, and the proper balance of air and water are necessary to grow crops efficiently. Management practices needed to improve yields include drainage, control of erosion, rotation of crops, use of suitable crop varieties, and the adequate use of lime and fertilizer. Lime and fertilizer should be applied according to the results of tests and field trials.

Many of the soils in Clinton County, such as Capac and Parkhill soils, need artificial drainage. Drainage of cultivated areas improves the air-water relationship in the root zone. Spring planting, spraying, and harvesting are hampered and weed control is more difficult if drainage is poor. Tile drains or surface drainageways or both can be used to remove excess water, but they should be properly designed. Suitable outlets are difficult to find in some areas, particularly on Sloan and Cohoctah soils. Diversions can be used in some areas to carry surface runoff away from the wet areas. Good soil structure and an ample supply of organic matter also benefit drainage. The low-lying areas are subject to a shortened growing season because of frost late in spring and early in fall. Low areas where water stands for more than a few days or weeks may be especially valuable for wildlife habitat and should not be drained.

The loss of surface soil as a result of erosion reduces productivity and increases the sediment in streams and in other bodies of water. This is common in steeper areas of Marlette and Morley soils. Erosion can generally be controlled by reducing the rate and volume of runoff and by increasing the rate of water absorption by the soil. Soil loss through surface runoff is reduced by growing meadow crops, cover crops, or green manure crops and by the proper use of crop residue. Contour cultivation, stripcrops, grassed waterways, minimum tillage, and diversions and terraces are also effective in controlling erosion. Windbreaks of

[2] This section was prepared with the assistance of RICHARD DRULLINGER, agronomist, Soil Conservation Service.

trees or shrubs help control soil blowing on Houghton and other muck soils, and on Boyer, Spinks, and other very sandy soils. Reducing width of fields, alternating small grain with strips of row crops, keeping crop residue on the soil surface, or planting permanent vegetative cover also help prevent soil blowing.

Practices to maintain and to improve the organic matter content and soil tilth include the growing of cover and green manure crops, the proper use of crop residues, minimum tillage, and the application of livestock manure. Fall plowing on nearly level, poorly drained or somewhat poorly drained soils, at the right moisture content, reduces damage to soil tilth and allows earlier tillage of the soils during the following spring. Fall plowing should not be done on sloping land or on soils subject to soil blowing. Grazing on wet loamy and clayey soils causes compaction of the soil and poor tilth. Good management is needed if the cropping system is intensive or if cultivation is continuous.

Additional help in managing the soils can be obtained by consulting the local representative of the Soil Conservation Service or the Cooperative Extension Service.

Following are descriptions of the capability units recognized in Clinton County and suggestions on use and management of the soils in each unit.

CAPABILITY UNIT IIe-1

The one soil in this unit, Morley loam, 2 to 6 percent slopes, is moderately well drained to well drained. The surface layer is loam, and the subsoil is silty clay loam and loam.

Permeability is moderately slow. Available water capacity is high, and runoff is medium.

This soil is well suited to row crops, small grains, hay, and pasture plants. Controlling erosion and maintaining good tilth and the content of organic matter are the major management needs. If tilled when wet, the surface layer of this soil becomes cloddy and hard when dry. Green manure crops and minimum tillage improve tilth and protect the soil against erosion. Small wet spots and small wet drainageways within areas of this soil delay planting and harvesting unless they are artificially drained.

CAPABILITY UNIT IIe-2

This unit consists of moderately well drained to well drained soils. The surface layer is loam or fine sandy loam, and the subsoil is clay loam, fine sandy loam, or silty clay loam. Slopes are 2 to 6 percent.

Permeability is moderate to moderately slow. Available water capacity is high, and runoff is medium.

The soils in this unit are well suited to row crops, small grains, hay, and pasture plants. Control of erosion and maintenance of good tilth and fertility are the major management needs. Minimum tillage, cover crops, terraces, and stripcrops help control erosion. Plowing under crop residue and green manure crops adds organic matter to the soil and improves tilth.

CAPABILITY UNIT IIe-3

This unit consists of moderately well drained and well drained soils. The surface layer is sandy loam, and the subsoil is sandy loam to clay loam. Slopes are 2 to 6 percent.

Permeability is moderately rapid to moderately low. Available water capacity is moderate to high, and runoff is slow to medium.

The soils in this unit are well suited to row crops, small grain, hay, and pasture plants. Control of erosion, maintenance of fertility and the content of organic matter, and conservation of moisture are the major management needs. Available water is generally not adequate for optimum crop growth during prolonged summer dry periods. These soils warm up early in spring and are easy to till throughout a wide range of moisture content. Minimum tillage, terracing, stripcropping, and contour tillage are effective in controlling erosion. Winter cover crops and crop residue on the surface help control erosion, maintain the supply of organic matter, improve tilth, and increase the capacity of the soils to absorb and hold water.

CAPABILITY UNIT IIe-4

The one soil in this unit, Blount loam, 2 to 6 percent slopes, is somewhat poorly drained. The surface layer is loam, and the subsoil is silty clay loam, clay loam, or silty clay.

Permeability is slow. Available water capacity is high, and runoff is medium.

This soil is well suited to row crops, small grain, hay, and pasture plants. Drainage, control of erosion, and maintenance of tilth and fertility are the major management needs. Drainage allows this soil to warm up more quickly in spring. If outlets are adequate, drainage facilities are not difficult to construct. Grassed waterways and shallow surface ditches plowed late in fall are used to carry off surface water. Cover crops, green manure crops, minimum tillage, and plowing under crop residue reduce erosion, improve tilth and fertility, and reduce surface crusting.

CAPABILITY UNIT IIw-1

This unit consists of somewhat poorly drained, poorly drained, and very poorly drained soils. The surface layer is loam or silty clay loam, and the subsoil is clay loam to silty clay. Slopes are 0 to 4 percent.

Permeability is moderate to slow. Available water capacity is high, and runoff is slow to ponded.

The soils in this unit are well suited to row crops, small grain, hay, and pasture plants. Drainage and maintenance of good tilth are the major management needs. These soils warm up slowly and dry slowly in spring unless drained. Drainage systems are not difficult to install on most of the soils in this unit. Shoals and Washtenaw soils are subject to flooding and ponding and lack drainage outlets in many areas. Trenches must be backfilled with porous material to increase the movement of water into drains in some places. The plowing under of crop residue and the use of green manure crops and minimum tillage improve tilth.

CAPABILITY UNIT IIw-2

Only Capac-Marlette loams, 1 to 6 percent slopes, is in this unit. These soils are well drained to somewhat poorly drained. The surface layer is loam, and the subsoil is clay loam.

Permeability is moderate to moderately slow. Available water capacity is high, and runoff is slow to medium.

These soils are well suited to row crops, small grain, hay, and pasture plants. Drainage and control of erosion are the major management needs. Design and layout of a drainage system is difficult in places as a result of complex soil and slope patterns. Some areas need only a random drainage system, whereas others need a complete drainage system. Minimum tillage and cover crops reduce erosion and improve tilth.

CAPABILITY UNIT IIw-3

This unit consists of somewhat poorly drained to very poorly drained soils. The surface layer is loam, and the subsoil is silt loam, silty clay loam, loam, clay loam, and sandy clay loam. Slopes are 0 to 3 percent.

Permeability is moderate to moderately slow. Available water capacity is moderate or very high, and runoff is slow to ponded.

The soils in this unit are well suited to row crops, small grain, hay, and pasture plants. Drainage is the major management need. Drainage is difficult to install in places because of the unstable underlying material. Because trench walls tend to cave, proper alinement of drainage lines is difficult. Drainage systems should be installed during dry periods. Special covering over drainage lines and careful backfilling are necessary to prevent soil material from flowing into and plugging the drains.

CAPABILITY UNIT IIw-4

This unit consists of somewhat poorly drained and poorly drained soils. The surface layer is sandy loam, and the subsoil is sandy loam and clay loam. Slopes are 0 to 4 percent.

Permeability is moderately rapid to moderately slow. Available water capacity is moderate to high, and runoff is slow to ponded.

The soils in this unit are well suited to row crops, small grain, hay, and pasture plants. Drainage is the major management need. Both surface drainage and subsurface drainage are needed in most places. Subsurface drainage should be installed during dry periods. Plowing under crop residue and green manure crops maintains the organic matter content and improves available water capacity.

CAPABILITY UNIT IIw-5

The one soil in this unit, Palms muck, is very poorly drained. The underlying material is silt loam. Slopes are 0 to 2 percent.

Permeability is moderately slow to moderately rapid in the muck layers and moderate in the underlying silt loam. Available water capacity is very high, and runoff is very slow to ponded.

This soil is well suited to vegetables, grass sod, mint, other specialty crops, and row crops. Drainage, protection against blowing, and maintenance of fertility are the major management needs. Drainage can be provided by surface drains and subsurface drains. Control of the water table is essential to prevent excessive drying and soil blowing and to retard decomposition of the muck. Cover crops, buffer strips, windbreaks, sprinkler irrigation, and compaction of the surface layer also reduce the hazard of soil blowing. Special fertilizer is needed.

CAPABILITY UNIT IIs-1

The one soil in this unit, Owosso sandy loam, 0 to 2 percent slopes, is well drained. The surface layer is sandy loam, and the subsoil is sandy loam, loam, and clay loam.

Permeability is moderately rapid in the upper part of the soil and moderately slow in the clay loam subsoil. Available water capacity is moderate, and runoff is slow.

This soil is well suited to row crops, small grain, hay, and pasture plants. Late maturing crops such as corn may show a moisture deficiency during prolonged dry periods. Conservation of moisture, maintenance of fertility and the content of organic matter, and control of erosion are the major management needs. Planting cover crops and leaving crop residue on the soil increase the capacity of the soil to absorb water, reduce the hazard of erosion, and add organic matter. Minimum tillage also reduces the hazard of erosion and conserves organic matter.

CAPABILITY UNIT IIIe-1

The one soil in this unit, Morley loam, 6 to 12 percent slopes, is moderately well drained to well drained. The surface layer is loam, and the subsoil is loam and silty clay loam.

Permeability is moderately slow. Available water capacity is high, and runoff is rapid.

This soil is well suited to row crops, small grain, hay, and pasture plants. Control of erosion and maintenance of good tilth and the supply of organic matter are the major management needs. If this soil is tilled when wet, the surface layer becomes cloddy and hard when dry. The use of cover crops, green manure crops, and minimum tillage improve tilth and protect the soil against erosion. Cropping systems that have a large proportion of close-growing crops are needed in erosion control. Contour stripcropping and contour farming reduce the hazard of erosion in areas where slopes are not complex.

CAPABILITY UNIT IIIe-2

The one soil in this unit, Marlette loam, 6 to 12 percent slopes, is moderately well drained to well drained. The surface layer is loam, and the subsoil is clay loam.

Permeability is moderate to moderately slow. Available water capacity is high, and runoff is rapid.

This soil is well suited to row crops, small grain, hay, and pasture plants. Control of erosion and maintenance of good tilth and fertility are the major management needs. Terraces and stripcropping help control erosion. The plowing under of crop residue and green manure crops and minimum tillage also help control erosion and maintain good tilth. Cropping systems that have a large proportion of close-growing crops help control runoff and erosion.

CAPABILITY UNIT IIIe-3

Only Owosso-Marlette sandy loams, 6 to 12 percent slopes, is in this unit. These soils are well drained to moderately well drained. The surface layer is sandy

loam, and the subsoil is sandy loam, clay loam, and loam.

Permeability is moderately rapid to moderately slow. Available water capacity is moderate to high, and runoff is medium.

These soils are moderately well suited to row crops and small grain and are well suited to hay and pasture plants. Control of erosion and conservation of moisture are the major management needs. Moisture is generally not adequate for optimum crop growth during prolonged summer dry periods. These soils warm up early in spring and are easy to till throughout a wide range of moisture content. Minimum tillage, terraces, stripcrops, and contour tillage help control erosion. Planting winter cover crops and leaving crop residue on the surface reduce the hazard of erosion, improve tilth and the supply of organic matter, and increase the capacity of the soils to absorb and hold water.

CAPABILITY UNIT IIIe-4

This unit consists of well drained soils. These soils have a surface layer of loamy sand or sandy loam and a subsoil of loamy sand, sandy loam, or sandy clay loam. Slopes range from 6 to 12 percent.

Permeability is moderately rapid or rapid. Available water capacity is low, and runoff is medium.

These soils are moderately well suited to row crops, small grain, and pasture plants. Control of erosion, conservation of moisture, and maintenance of fertility are the major management needs. Moisture is sometimes inadequate for optimum plant growth during dry summer months. These soils warm up early in spring and are easily tilled. Minimum tillage and stripcropping are effective in controlling erosion. Rotations that include a high proportion of close-growing crops also help in erosion control. Plowing under crop residue, green manure crops, and barnyard manure maintains the supply of organic matter, improves available water capacity, and reduces the hazard of erosion.

CAPABILITY UNIT IIIw-1

This unit consists of somewhat poorly drained to very poorly drained soils. The surface layer is loamy sand or sandy loam. The subsoil is typically loamy sand, sandy loam, and sand, but in a few areas it is clay loam.

Available water capacity is generally low, but it is medium where the subsoil is clay loam. Permeability is rapid in the upper part of the profile and moderate in the lower part. Runoff is slow to ponded.

These soils are moderately well suited to row crops, small grain, and pasture plants. Drainage, maintenance of fertility, protection against soil blowing, and conservation of moisture are the major management needs. Subsurface and surface drainage systems remove excess water effectively. Drainage systems should be installed when the soil is dry because ditchbanks cave in readily when the soil is wet. Windbreaks, minimum tillage, stripcrops, and crop residue on the surface reduce the hazard of soil blowing. Plowing under crop residue and green manure crops maintains fertility and increases available water capacity. Frequent light applications of fertilizer are better than a single heavy application.

CAPABILITY UNIT IIIw-2

This unit consists of somewhat poorly drained to very poorly drained soils. These soils have a surface layer of fine sandy loam or loam and a subsoil of loamy sand, sandy loam, or silt loam. In some areas the subsoil is muck. Slopes are 0 to 2 percent.

Permeability is typically moderate to moderately rapid but is moderately slow to moderately rapid in the muck subsoil. Available water capacity is moderate to very high, and runoff is very slow to ponded.

These soils are well suited to row crops. Frost is a hazard. Drainage and protection from flooding are the major management needs. Some areas lack suitable outlets and cannot be drained by conventional methods. The hazard of flooding can be reduced by selecting crops that can be planted late in the growing season. Selecting frost-hardy crops and planting where air drainage is good reduces the frost hazard. Minimum tillage and plowing under crop residue maintain soil tilth.

CAPABILITY UNIT IIIw-3

The one soil in this unit, Houghton muck, is very poorly drained. The underlying material is muck to a depth of 50 inches or more. Slopes are 0 to 2 percent.

Permeability is moderately slow to moderately rapid. Available water capacity is very high, and runoff is very slow to ponded.

This soil is well suited to corn, vegetables, mint, grass sod, and other specialty crops. Drainage, protection against soil blowing, and maintenance of fertility are the major management needs. Control of the water table is essential to prevent excessive drying and soil blowing and to retard decomposition of the muck. The danger of settling can be reduced by allowing the water to rise to the surface when no crop is growing. Windbreaks, buffer strips, stripcrops, sprinkler irrigation, and compaction of the surface layer also reduce the hazard of soil blowing. Special fertilizer is needed.

CAPABILITY UNIT IIIs-1

This unit consists of well drained soils. The surface layer is loamy sand or sandy loam, and the subsoil is loamy sand to clay loam. Slopes are 0 to 6 percent.

Permeability is rapid to moderately rapid. In places it is very rapid in the upper part of the soil and moderately slow in the lower part. Available water capacity is moderate or low, and runoff is medium to very slow.

These soils are moderately well suited to row crops, small grain, and pasture plants. Control of erosion, conservation of moisture, and maintenance of fertility and the supply of organic matter are the major management needs. Windbreaks, stripcrops, and minimum tillage help control erosion. Crop residue left on the surface and the use of cover crops protect the soil against blowing. Large applications of fertilizer are not beneficial in dry years when moisture is the critical factor affecting crop yields. Crops that resist drought and mature early should be selected because of the possible shortage of moisture late in the growing season.

CAPABILITY UNIT IVe-1

The one soil in this unit, Marlette loam, 12 to 18 percent slopes, is moderately well drained to well

drained. The surface layer is loam, and the subsoil is clay loam. Slopes range from 12 to 18 percent.

Permeability is moderate to moderately slow. Available water capacity is high, and runoff is rapid.

This soil is moderately well suited to small grain and forage crops but is poorly suited to row crops. Control of erosion and maintenance of the supply of organic matter are the major management needs. The surface layer tends to crust when dry. Contour farming, terracing, stripcropping, minimum tillage, cover crops, and grasses and legumes in the cropping system help in erosion control. Crop residue should be left on the surface or incorporated into the plow layer.

CAPABILITY UNIT IVe–2

The one soil in this unit, Marlette clay loam, 6 to 12 percent slopes, severely eroded, is well drained. The surface layer and subsoil are clay loam.

Permeability is moderate or moderately slow. Available water capacity is high, and runoff is rapid.

This soil is moderately well suited to small grain and forage crops and is poorly suited to row crops. Preventing further erosion, maintaining the supply of organic matter, and improving tilth are the major management needs. The surface layer crusts when dry. Contour farming, terracing, minimum tillage, the use of cover crops, and grasses and legumes in the cropping system help in erosion control. Crop residue and barnyard manure partially incorporated into the surface layer reduce crusting and improve tilth. Proper timing of tillage prevents further deterioration of tilth. Small grain and forage plants should make up a large part of the cropping system.

CAPABILITY UNIT IVe–3

This unit consists of Boyer complex, 12 to 18 percent slopes. These are well drained soils with a surface layer of loamy sand or sandy loam and a subsoil of sandy loam, loamy sand, and sandy clay loam.

Permeability is moderately rapid. Available water capacity is low, and runoff is rapid.

This soil is moderately well suited to small grain and forage crops and is poorly suited to row crops. Controlling erosion and conserving moisture are the major management needs. Soil blowing is a hazard if large areas are cultivated. Minimum tillage and stripcropping conserve moisture and reduce erosion. Crop residue left on the surface and the use of cover crops protect the soil from erosion and reduce the hazard of soil blowing. Large applications of fertilizer are not beneficial in dry years when moisture is the critical factor affecting crop yields. Crops that resist drought and mature early should be selected because of the possible shortage of moisture late in the growing season. Where other conservation practices are not feasible, a permanent cover of grass is needed in erosion control.

CAPABILITY UNIT IVw–1

The one soil in this unit, Adrian muck, is very poorly drained. The underlying material is sand. Slopes are 0 to 2 percent.

Permeability is moderately slow to moderately rapid. Available water capacity is high, and runoff is very slow to ponded.

This soil is moderately suited to corn, vegetables, mint, and grass sod (fig. 9).

Drainage, protection against blowing, and maintenance of fertility are the major management needs. Control of the water table is essential to prevent excessive drying and soil blowing and to retard decomposition of the muck. The danger of settling can be reduced by allowing the water to rise to the surface when no crop is growing. Windbreaks, buffer strips, stripcrops, sprinkler irrigation, and compaction of the surface layer also reduce the hazard of soil blowing. Special fertilizer is needed.

CAPABILITY UNIT IVw–2

The one soil in this unit, Edwards muck, is very poorly drained. The underlying material is marl. Slopes are 0 to 2 percent.

Permeability is moderately slow to moderately rapid in the muck but is variable in the underlying marl. Available water capacity is very high, and runoff is very slow to ponded.

This soil is moderately well suited to corn, vegetables, grass sod, and other specialty crops. Drainage, protection against blowing, and maintenance of fertility are the major management needs. Control of the water table is essential to prevent excessive drying and soil blowing and to retard decomposition of the muck. Because of the variable nature of the underlying marl, onsite investigation is needed to determine if subsurface drainage is feasible. The danger of settling can be reduced by allowing the water to rise to the surface when no crop is growing. Windbreaks, buffer strips, stripcrops, sprinkler irrigation, and compaction of the surface layer also reduce the hazard of soil blowing. Special fertilizer is needed.

CAPABILITY UNIT IVs–1

The one soil in this unit, Oakville fine sand, 0 to 6 percent slopes, is well drained to moderately well drained. The surface layer and subsoil are fine sand.

Permeability is very rapid. Available water capacity is low, and runoff is very slow.

This soil is poorly suited to cultivated crops. Conserving moisture, reducing the hazard of soil blowing, and improving fertility are the major management needs. Windbreaks, cover crops, stripcrops, minimum tillage, and crop residue on the surface help reduce the hazard of blowing. Minimum tillage conserves moisture. Large applications of fertilizer are not beneficial in dry years because of the low available water capacity.

CAPABILITY UNIT Vs–1

The one soil in this unit, Spinks cobbly loamy sand, cobbly variant, 0 to 6 percent slopes, is well drained. The surface layer is cobbly loamy sand, and the subsoil is cobbly sand, sandy loam, and cobbly loamy sand.

Permeability is rapid. Available water capacity is low, and runoff is slow.

This soil is well suited to woodland, but equipment limitations are severe because of stoniness. Where fertilization and tillage are possible, the soil can be used for pasture or hay. Soil blowing is a hazard if the surface is left bare.

Figure 9.—**Grass sod for lawns is a special crop on Adrian muck.**

CAPABILITY UNIT VIe–1

The one soil in this unit, Marlette loam, 18 to 25 percent slopes, is well drained. The surface layer is loam, and the subsoil is clay loam.

Permeability is moderate to moderately slow. Available water capacity is high, and surface runoff is rapid.

This soil is moderately well suited to pasture and hay and is well suited to woodland. The erosion hazard is severe. Keeping the soil in close growing vegetation helps control erosion. Because of the erosion hazard, tillage should be kept to a minimum when establishing pasture or hay. Careful management of grazing reduces the hazard of erosion and lessens compaction.

CAPABILITY UNIT VIe–2

The one soil in this unit, Marlette clay loam, 12 to 18 percent slopes, severely eroded, is well drained. The surface layer and subsoil are clay loam.

Permeability is moderately slow. Available water capacity is high, and runoff is rapid.

This soil is moderately well suited to pasture and hay and is well suited to woodland. Erosion is severe. Keeping the soil in close growing vegetation helps prevent further erosion. Because of the erosion hazard, tillage should be kept to a minimum when establishing pasture or hay. Careful management of grazing reduces the hazard of erosion and lessens compaction.

CAPABILITY UNIT VIe–3

The one soil in this unit, Boyer complex, 18 to 25 percent slopes, is well drained. The surface layer is loamy sand or sandy loam, and the subsoil is loamy sand, sandy loam, and sandy clay loam.

Permeability is moderately rapid. Available water capacity is low, and runoff is rapid.

These soils are moderately well suited to pasture and hay and are well suited to woodland. Erosion can be controlled by keeping the soil in close-growing vegetation. Because of the erosion hazard, tillage should be kept to a minimum when establishing pasture or hay. Pasture and hay plants may lack adequate moisture in dry summer months because of the low available water capacity. Careful management of grazing reduces the erosion hazard.

CAPABILITY UNIT VIIe–1

This unit consists of Borrow land, or areas where varying depths of soil material have been removed. The material includes sand, loamy sand, gravelly sand, sandy loam, loam, and clay loam.

Borrow land has potential for recreational use in some places.

The material is low in organic matter. A few areas are subject to intermittent ponding. Some are subject to erosion. Establishing a permanent cover of grass or trees helps prevent further erosion.

Predicted Yields[3]

The soils of Clinton County vary considerably in productivity. Some consistently produce high yields of cultivated crops. Others are better suited to less intensive use because of soil limitations or the hazard of erosion.

The average per acre yields under high level management of the principal crops for most soils of the county are listed in table 2. Under high level, or improved, management the cropping system is adapted to the soil by using the proper proportion of row crops to legume-grass crops. The crop sequence is then supplemented with the necessary measures needed to control erosion and reduce the hazard of soil blowing.

Examples of such measures are contour tillage, stripcropping, minimum tillage, and crop residue on the surface. The amount of lime applied is determined by soil testing. The application of fertilizer, also determined by soil testing, is based on the amounts and kinds of plant nutrients needed by the crop. Where needed, an adequate system of artificial drainage is installed. Improved varieties of plants and high quality seeds are used. Weed, disease, and insect control are practiced. Suitable methods and proper timing of tillage and harvesting are needed. Cover crops, crop residue, and manure improve soil structure, supply organic matter, and help to control erosion.

The crop yields listed in table 2 are those expected over a period of several years. The yields are not presumed to be the maximum obtainable.

Maximum yields can be considerably higher in years when soil, plant, and weather conditions are favorable. Irrigation is not considered a part of improved management because it is limited mainly to the production of potatoes, truck crops, and fruit crops.

The yields predicted indicate the relative productivity of the soils in Clinton County.

Woodland[4]

At the time of settlement, all of Clinton County was dense forest, largely of deciduous trees. The few small oak openings were commonly referred to as "prairies."

Sugar maple and associated hardwoods were on the better drained loamy uplands. The percentage of oak increased where the soils were more sandy. White pine grew in the deep, dry sand areas. The elm, ash, red maple type forest was favored on the poorly drained mineral soils. The plant cover on muck soils ranged from a hardwood cover similar to that on the wet mineral soils to a cedar and tamarack forest or a cover of cattail, marshgrass, and shrubs.

The first commercial logging began around 1850 and continued until about 1880. This early logging and subsequent clearing of the land for farming left only scattered woodlots as remnants of the original forest cover. All of the old growth has been harvested. Except for a few pine plantations, existing woodlots are mainly regrowth of the original forest.

About 7 percent of the county is wooded. Only a few woodlots are managed for sustained hardwood timber production.

Woodland suitability groups

The soils of Clinton County have been assigned to five woodland suitability groups to assist owners in planning the use of their soils for wood crops. Each group is made up of soils that are suited to the same kinds of trees, that need approximately the same kind of management if the plant cover is similar, and that have about the same potential productivity.

Each woodland suitability group is identified by a three-part symbol, for example, 2r1, 2o4, or 5w1. The first part of the symbol, always an Arabic numeral, is the woodland suitability class, which indicates relative potential productivity of the soils in the group. The numeral 1 indicates high potential productivity, 2 medium high, 3 medium, 4 medium low, and 5 low.

Following is the approximate yield per acre, by woodland suitability class, of indicator forest types or key species.

Northern red oak-sugar maple-red maple:

	Board feet	*Cords*
Class 1	More than 260	More than 1
Class 2	190 to 260	0.8 to 1
Class 3	130 to 190	0.6 to 0.8
Class 4	90 to 130	0.4 to 0.6
Class 5	Less than 90	Less than 0.4

Aspen:

	Board feet	*Cords*
Class 1	More than 200	More than 1.2
Class 2	150 to 200	0.8 to 1.2
Class 3	125 to 150	0.5 to 0.8
Class 4	100 to 125	0.2 to 0.5
Class 5	Less than 100	Less than 0.2

One cubic foot equals about 5 board feet, and about 2.5 cords equal 1,000 board feet (International ¼-inch rule). A cord is dimensionally 128 cubic feet but equals only about 80 cubic feet of wood. Production of 0.2 cord or less is "noncommercial" by definition.

The yields apply to managed stands with intermediate cuttings to use trees that would be crowded out and to provide ample room for the crop trees to develop.

The ratings are determined from field evaluations that include measuring site index. These site index figures are obtained by measuring the height and age of the dominant trees of a given species on a specified kind of soil in natural unmanaged stands. For hardwoods and softwoods in this county, the site index is based on the height reached in a specified number of years. Research studies of site index have been used to estimate approximate expected growth and yield per acre in cords and in board feet.

The second part of the woodland suitability group symbol, a small letter, represents an important soil property. The letter *w* means that water in or on the soil, either seasonally or year round, is the chief limitation; *s*, that the soils are sandy and dry, have little or no difference in texture between the surface layer and subsoil (or B horizon), have low available water capacity, and generally have a low supply of plant

[3] This section was prepared with the assistance of WILLIAM LASHER, agricultural agent, Cooperative Extension Service, and LLOYD B. CAMPBELL, Soil Conservation Service.

[4] JACQUES J. PINKARD, forester, Soil Conservation Service, helped prepare this section.

TABLE 2.—*Predicted average yields per acre under high level management*

[Dashes indicate that the crop is not suited to the soil or is not ordinarily grown on it. Only arable soils are listed]

Soil	Corn	Corn silage	Oats	Wheat	Soybeans	Field beans	Sugar beets	Grass-legume hay
	Bushels	*Tons*	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Tons*	*Tons*
Adrian muck	90	15			35			
Blount loam, 0 to 2 percent slopes	105	18	70	48	40	35	19	5.7
Blount loam, 2 to 6 percent slopes	100	16	70	55	35	34	17	5.2
Boyer sandy loam, 0 to 6 percent slopes	75	14	65	35	30	25		3.7
Boyer sandy loam, 6 to 12 percent slopes	68	12	60	28	26	18		3.0
Boyer complex, 0 to 6 percent slopes	65	12	45	35	25	23		3.7
Boyer complex, 6 to 12 percent slopes	60	10	40	28	18	18		3.0
Boyer complex, 12 to 18 percent slopes								2.5
Boyer complex, 18 to 25 percent slopes								2.5
Capac loam, 0 to 4 percent slopes	120	18	95	60	40	35	20	5.2
Capac-Marlette loams, 1 to 6 percent slopes	108	16	90	55	40	34	18	4.7
Ceresco fine sandy loam	105	20			45	43		
Cohoctah loam	95	16			45	43		
Colwood loam	120	20	90	50	40	43	23	5.7
Corunna sandy loam	110	18	90	60	40	43	21	5.0
Edwards muck	90	15						
Gilford sandy loam	90	15	70	50	30	30		4.2
Granby loamy sand	80	13	50	38	28	23		3.6
Houghton muck	100	17			35			
Kibbie loam, 0 to 3 percent slopes	110	18	80	60	38	35	20	5.0
Lapeer sandy loam, 2 to 6 percent slopes	85	14	65	45	30	28	14	4.2
Marlette loam, 2 to 6 percent slopes	105	17	80	55	35	30	17	5.0
Marlette loam, 6 to 12 percent slopes	95	16	70	50	27	25		4.5
Marlette loam, 12 to 18 percent slopes	80	12	58	40	20	20		3.5
Marlette loam, 18 to 25 percent slopes								3.0
Marlette clay loam, 6 to 12 percent slopes, severely eroded	65	10	55	35				2.5
Marlette clay loam, 12 to 18 percent slopes, severely eroded								2.5
Matherton loam, 0 to 3 percent slopes	105	17	75	50	30	31	19	4.0
Metamora-Capac sandy loams, 0 to 4 percent slopes	115	18	88	60	35	30	20	5.0
Metea loamy sand, 2 to 6 percent slopes	90	14	60	45	30	27		4.0
Morley loam, 2 to 6 percent slopes	95	15	70	49	30	27		4.7
Morley loam, 6 to 12 percent slopes	85	14	65	44	27	24		4.5
Oakville fine sand, 0 to 6 percent slopes	50	10	44	26				3.2
Oshtemo sandy loam, 2 to 6 percent slopes	72	12	60	32	25	21		3.4
Owosso sandy loam, 0 to 2 percent slopes	100	15	75	50	30	28		4.7
Owosso-Marlette sandy loams, 2 to 6 percent slopes	100	15	75	50	38	28		4.7
Owosso-Marlette sandy loams, 6 to 12 percent slopes	90	14	70	45	26	24		4.2
Palms muck	110	17			40			
Parkhill loam	125	20	90	60	45	43	23	6.0
Sebewa loam	110	17	80	55	33	30	21	5.0
Selfridge loamy sand, 0 to 4 percent slopes	90	15	70	42	32	30	16	4.4
Shoals loam	130	20			45	40	20	
Sims silty clay loam	115	19	90	60	40	37	23	6.2
Sisson fine sandy loam, 2 to 6 percent slopes	100	16	80	54	30	27		4.5
Sloan loam	110	18			40	35	23	
Spinks loamy sand, 0 to 6 percent slopes	65	11	55	30	24	20		3.7
Spinks loamy sand, 6 to 12 percent slopes	60	10	35	27	20	16		3.0
Thetford loamy sand, 0 to 3 percent slopes	80	15	65	40	30	27		4.0
Wallkill loam	100	17			35			
Wasepi sandy loam, 0 to 3 percent slopes	80	15	65	40	30	27		4.0

nutrients; *r*, that the main limitation is steep slopes; and *o*, that the soils have few limitations that restrict their use for trees.

The third part of the symbol, another Arabic numeral, relates to soils that have similar response to management. The hazards or limitations that affect management of soils for woodland are erosion hazard, equipment limitations, seedling mortality, windthrow hazard, and plant competition. Each hazard or limitation is expressed as slight, moderate, or severe.

Erosion hazard is rated according to the risk of erosion on woodland that is not protected by special practices but is otherwise well managed. The hazard is *slight* if the problems of erosion control are small; *moderate* if attention to treatment is needed during or after logging or logging construction; and *severe* if intensive measures are needed to avoid excessive soil losses.

Equipment limitations differ according to slope, soil wetness, and other factors that restrict or prohibit the use of equipment commonly used in tending and harvesting trees. Equipment limitations are *slight* if the kind of equipment and its season of use are not restricted; *moderate* if not all kinds of equipment can be used and the period when equipment cannot be used is no more than 3 months; and *severe* if the type of equipment used is limited and the period when equipment cannot be used is more than 3 months.

Seedling mortality refers to the mortality of planted tree seedlings influenced by the kinds of soil or topography when plant competition is not a limiting factor. The rating is *slight* if expected mortality is between 0 and 25 percent; *moderate* if between 25 and 50 percent; and *severe* if more than 50 percent.

Windthrow hazard is the danger of trees being blown over by the wind. It is *slight* if the effective rooting depth is 20 inches or more and trees are seldom blown down during storms. It is *moderate* if the effective rooting depth is 10 to 20 inches and trees are blown down during storms when the soil is excessively wet. It is *severe* if the effective rooting depth is less than 10 inches to bedrock or less than 15 inches to a fragipan or claypan and trees are often blown down during storms.

Plant competition is the invasion or growth of unwanted shrubs, trees, or other plants when openings are made in the canopy by fire, logging, or by other factors. Competition is *slight* if competing plants do not prevent the natural regeneration or the early growth of desirable species or do not interfere with the growth of planted seedlings. It is *moderate* if competing plants delay natural or artificial regeneration but do not prevent the growth of a normal, fully stocked stand. Competition is *severe* if competing plants prevent adequate natural restocking or natural regeneration unless the site is intensively prepared and maintained by weeding or other practices.

Table 3 lists the management problems, important trees, site indexes, and trees suitable for planting for each woodland suitability group in Clinton County. The woodland suitability group for each soil is listed in the Guide to Mapping Units. The site index figures in table 3 refer to the first species listed under "Important Trees."

Trees and shrubs for landscaping and windbreaks [5]

Knowing the limitations and capabilities of soils for various plantings is essential in landscaping and in establishing windbreaks. Plantings help in erosion control. They also conserve water and moisture, promote beauty, and screen unsightly developments. They are needed in developing recreational facilities.

The soils of Clinton County are assigned to woody plant groups, as shown in table 4. Each group consists of soils that are suited to similar kinds of shrubs and trees. Suitable landscape plantings and windbreaks are listed for each group. Also listed is the height at maturity for each planting, the shape, and the shade tolerance. The woody plant group for each individual soil is identified in the descriptions of the soils.

Success in establishing the plants can be expected if the area is properly prepared and managed. This includes drainage before planting and control of competing plants for at least 2 years, or until the desired plants are established. The plants listed in each group are some of those commonly used; others may also be suitable. Some of the plants are shown in more than one group because they are suited to several combinations of circumstances. Many plantings can serve such dual purposes as providing wildlife food and cover, as well as providing windbreaks and improving the environment.

Wildlife [6]

Proper manipulation of soil, water, and plants to produce suitable wildlife habitat is most effective in maintaining and improving wildlife populations (fig. 10).

Table 5 rates the soils according to their level of suitability for elements of wildlife habitat and for general kinds of wildlife. A rating of *good* means that habitat is easily improved, maintained, or created. There are few or no soil limitations in habitat management, and satisfactory results can be expected. A rating of *fair* indicates that habitat can be improved, maintained, or created on these soils, but moderate soil limitations affect habitat management or development. A moderate intensity of management and fairly frequent attention may be required to insure satisfactory results. A rating of *poor* means that habitat can be improved, maintained, or created on these soils, but the soil limitations are severe. Habitat management may be difficult and expensive and may require intensive effort. Results are questionable. A rating of *very poor* indicates that under the prevailing soil conditions, it is impractical to attempt to improve, maintain, or create habitat. Unsatisfactory results are probable.

Elements of wildlife habitat for which soils are rated according to their suitability include the following:

Grain and seed crops are domestic grain or other seed-producing annuals planted to provide food for wildlife. Examples are corn, wheat, oats, rye, barley, buckwheat, millet, sorghum, soybeans, and sunflowers.

Domestic grasses and legumes are domestic peren-

[5] JACQUES J. PINKARD, forester, Soil Conservation Service, helped to prepare this section.

[6] CHARLES M. SMITH, biologist, Soil Conservation Service, helped prepare this section.

TABLE 3.—*Wood crops and management*

Woodland suitability groups and map symbols	Management problems					Potential productivity	
	Hazard of erosion	Equipment limitations	Seedling mortality	Hazard of windthrow	Plant competition	Important trees	Site index
Group 1o1: OtA, OwB, OwC, SnB **For Marlette part of OwB and OwC, see group 2o1.**	Slight	Slight	Slight	Slight	Moderate	Northern red oak, black cherry, sugar maple, white oak.	>70
Group 2o1: MaB, MaC, MaD, MbC3, MbD3	Slight	Slight	Slight	Slight	Moderate	Sugar maple, northern red oak, white ash, black walnut.	58–65
Group 2o2: LaB, MoB, MoC	Slight	Slight	Slight	Slight	Moderate	Northern red oak, sugar maple, white ash, black walnut, American basswood.	61–70
Group 2o4: BdA, BdB, CaA, CbB, Ce, KbA, MdA, MeA[1], Sh. **For Marlette part of CbB, see group 2o1.**	Slight	Slight	Slight	Slight	Moderate	Northern red oak, sugar maple, American basswood, black oak.	61–70
Group 2w1: Ch, Pr, Sb, Sm, So, Wd	Slight	Severe	Severe	Severe	Severe	Red maple, eastern cottonwood, silver maple, white ash.	61–70
Group 2r1: MaE	Moderate	Moderate	Slight	Slight	Moderate	Sugar maple, northern red oak, white ash, black walnut.	58–65
Group 2s5: BnB, BnC, BoB[1], BoC[1], BoD[1], MhB, OsB, SpB, SpC.	Slight	Slight	Moderate	Slight	Moderate	Northern red oak, white oak, shagbark hickory, sugar maple.	61–70
Group 2s6: BoE[1]	Moderate	Moderate	Moderate	Slight	Moderate	Northern red oak, white oak, shagbark hickory, sugar maple.	61–70
Group 2s8: StB	Slight	Severe	Moderate	Slight	Moderate	Northern red oak, white oak, shagbark hickory, sugar maple.	61–70

Group 2s9: OaB	Slight	Slight	Severe	Slight	Moderate	Northern red oak, white oak, shagbark hickory, sugar maple.	61–70
Group 3w1: Co, Gf	Slight	Severe	Severe	Severe	Severe	Red maple, big tooth aspen, white ash, silver maple.	51–60
Group 3w2: Cr	Slight	Severe	Moderate	Moderate	Severe	Red maple, big tooth aspen, white ash, silver maple.	51–60
Group 3s3: SeA, ThA, WbA	Slight	Slight	Moderate	Slight	Slight	Quaking aspen, American beech, black oak, red maple.	56–65
Group 4w2: Ad, Ed, Ho, Pa, Wa	Slight	Severe	Severe	Severe	Severe	Red maple, white ash, swamp white oak, silver maple.	41–50
Group 5w1: Gr	Slight	Severe	Severe	Severe	Severe	Quaking aspen, silver maple, red maple, eastern cottonwood.	<45

[1] Ratings are the same for both soils in this mapping unit.

TABLE 4.—*Environmental improvement and windbreaks*

[Suitable plants for windbreaks are identified by asterisks]

Woody plant groups and map symbols	Suitable trees and shrubs	20-year height in feet	Shape	Shade tolerance
Group 1: Ad, Ed, Ho, Pa, Wa.	American cranberry bush*	10	Oval	No.
	Amur privet*	12	Round	No.
	Austrian pine*	22	Pyramid	No.
	Eastern hemlock	20	Pyramid	Yes.
	Eastern white pine*	22	Pyramid	Yes.
	Green ash*	37	Oval	No.
	Laurel willow*	24	Oval	No.
	Northern white-cedar*	29	Columnar	Yes.
	Nannyberry viburnum*	18	Round	No.
	Norway spruce*	27	Conical	No.
	Red maple	46	Oval	Yes.
	Red-osier dogwood	9	Mound	Some.
	Scotch pine*	31	Pyramid	No.
	Silky dogwood*	9	Round	No.
	Tamarack*	16	Conical	No.
	Tatarian honeysuckle*	15	Round	No.
	Vanhoutte spirea*	7	Round	No.
	White spruce*	13	Conical	Some.
Group 2: BdA, BdB, CaA, CbB, Ce, Ch, KbA, MdA, MeA, Pr, Sb, SeA, Sh, Sm, So, ThA, WbA, Wd. For Marlette part of CbB, see group 3.	American basswood	30	Round	Some.
	American cranberrybush*	8	Oval	No.
	Amur privet*	11	Round	No.
	Austrian pine*	22	Pyramid	No.
	Black walnut	26	Round	Some.
	Blue spruce*	9	Conical	No.
	Eastern redcedar	14	Conical	No.
	Eastern white pine*	24	Pyramid	Yes.
	Green ash*	39	Oval	No.
	Late lilac*	12	Oval	No.
	Laurel willow*	29	Oval	No.
	Northern white-cedar*	23	Columnar	Yes.
	Norway spruce*	26	Conical	Some.
	Red maple	46	Oval	Some.
	Red pine*	26	Pyramid	No.
	Siberian crabapple	25	Vase	No.
	Silky dogwood	10	Round	No.
	Tallpurple willow	25	Oval	No.
	Tatarian honeysuckle*	12	Round	No.
	Vanhoutte spirea*	7	Round	No.
	White ash*	39	Round	No.
	White spruce*	14	Conical	Some.
	Whitebelle honeysuckle*	10	Round	No.
Group 3: BnB, BnC, BoB, BoC, BoD, BoE, LaB, MaB, MaC, MaD, MaE, MbC3, MbD3, MhB, MoB, MoC, OaB, OsB, OtA, OwB, OwC, SnB, SpB, SpC, StB.	American basswood	35	Round	Some.
	Amur privet*	12	Round	No.
	Austrian pine	25	Pyramid	No.
	Autumn-olive*	15	Oval	No.
	Black walnut	23	Round	Yes.
	Eastern white pine*	28	Pyramid	Yes.
	Flowering dogwood	13	Flat-top	Yes.
	Green ash	49	Oval	No.
	Hackberry	28	Pyramid	Some.
	Juneberry*	12	Oval	Yes.
	Late lilac*	14	Oval	No.
	Laurel willow*	25	Oval	No.
	Lilac*	14	Oval	Yes.
	Northern pin oak*	28	Pyramid	No.
	Northern white-cedar*	19	Columnar	Yes.
	Norway spruce*	26	Conical	No.
	Red pine*	22	Pyramid	No.
	Scotch pine*	31	Pyramid	No.
	Shagbark hickory	30	Oval	Some.
	Silky dogwood	9	Round	No.
	Tatarian honeysuckle*	7	Round	No.
	White spruce*	20	Conical	Yes.
	Vanhoutte spirea*	7	Round	No.
	Whitebelle honeysuckle*	9	Round	No.

TABLE 4.—*Environmental improvement and windbreaks*—Continued

Woody plant groups and map symbols	Suitable trees and shrubs	20-year height in feet	Shape	Shade tolerance
Group 4: Co, Cr, Gf, Gr.	American elder	9	Round	No.
	American sycamore	27	Round	Yes.
	Amur privet*	8	Round	No.
	Arrowwood*	12	Round	No.
	Black cherry	40	Oval	Some.
	Eastern hemlock	21	Pyramid	Yes.
	Eastern white pine*	17	Pyramid	Yes.
	Green ash	25	Oval	No.
	Hawthorn*	15	Round	No.
	Laurel willow*	22	Oval	No.
	Northern white-cedar*	21	Columnar	Yes.
	Norway spruce*	25	Conical	No.
	Paper birch	31	Oval	Some.
	Siberian crabapple*	15	Vase	No.
	Silky dogwood*	8	Round	No.
	Tamarack*	16	Pyramid	No.
	White spruce	10	Pyramid	No.
	Whitebelle honeysuckle*	10	Round	No.

Figure 10.—**Management that provides habitat is highly important to wildlife.**

TABLE 5.—*Wildlife*

Soil series and map symbols	Elements of habitat			
	Grain and seed crops	Domestic grasses and legumes	Wild herbaceous plants	Hardwood trees
Adrian: Ad	Very poor	Poor	Poor	Poor
Blount:				
BdA	Fair	Good	Good	Good
BdB	Fair	Good	Good	Good
Boyer:				
BnB	Good	Good	Good	Good
BnC	Fair	Good	Good	Good
BoB, BoC, BoD, BoE	Poor	Fair	Good	Good
Capac:				
CaA	Good	Good	Good	Good
CbB	Good	Good	Good	Good
For Marlette part of CbB, see Marlette series.				
Ceresco: Ce	Fair	Good	Good	Good
Cohoctah: Ch	Fair	Fair	Fair	Fair
Colwood: Co	Good	Fair	Fair	Fair
Corunna: Cr	Good	Fair	Fair	Fair
Edwards: Ed	Fair	Poor	Poor	Poor
Gilford: Gf	Fair	Poor	Poor	Poor
Granby: Gr	Poor	Fair	Fair	Fair
Houghton: Ho	Fair	Poor	Poor	Poor
Kibbie: KbA	Good	Good	Good	Good
Lapeer: LaB	Good	Good	Good	Good
Marlette:				
MaB	Good	Good	Good	Good
MaC, MaD	Fair	Good	Good	Good
MaE	Poor	Fair	Good	Good
MbC3	Fair	Good	Good	Good
MbD3	Poor	Fair	Good	Good
Matherton: MdA	Good	Good	Good	Good
Metamora: MeA	Good	Good	Good	Good
For Capac part of MeA, see Capac series.				
Metea: MhB	Poor	Fair	Good	Good
Morley:				
MoB	Good	Good	Good	Good
MoC	Fair	Good	Good	Good
Oakville: OaB	Poor	Poor	Fair	Poor
Oshtemo: OsB	Good	Good	Good	Good
Owosso:				
OtA	Good	Good	Good	Good
OwB	Good	Good	Good	Good
OwC	Fair	Good	Good	Good
For Marlette part of OwB and OwC, see Marlette series.				
Palms: Pa	Good	Poor	Poor	Poor
Parkhill: Pr	Good	Fair	Fair	Fair

habitat

Elements of habitat—*Continued*			Kinds of habitat		
Coniferous plants	Wetland plants	Shallow water areas	Openland	Woodland	Wetland
Poor	Good	Good	Poor	Poor	Good.
Good	Fair	Fair	Good	Good	Fair.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Fair	Fair	Good	Good	Fair.
Good	Poor	Poor	Good	Good	Poor.
Good	Fair	Fair	Good	Good	Fair.
Poor	Good	Good	Fair	Fair	Good.
Fair	Good	Good	Fair	Fair	Good.
Fair	Good	Good	Fair	Fair	Good.
Poor	Good	Good	Poor	Poor	Good.
Poor	Good	Good	Poor	Poor	Good.
Fair	Fair	Good	Fair	Fair	Fair.
Poor	Good	Good	Poor	Poor	Good.
Fair	Fair	Fair	Good	Good	Fair.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Fair	Fair	Fair	Good	Good	Fair.
Good	Fair	Fair	Good	Good	Fair.
Good	Poor	Very poor	Fair	Good	Very poor.
Good	Poor	Poor	Good	Good	Poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Poor	Poor	Very poor	Poor	Poor	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Poor	Good	Good	Fair	Poor	Good.
Fair	Good	Good	Fair	Fair	Good.

TABLE 5.—*Wildlife*

Soil series and map symbols	Elements of habitat			
	Grain and seed crops	Domestic grasses and legumes	Wild herbaceous plants	Hardwood trees
Sebewa: Sb	Good	Fair	Fair	Fair
Selfridge: SeA	Poor	Fair	Good	Good
Shoals: Sh	Poor	Fair	Fair	Good
Sims: Sm	Good	Poor	Poor	Poor
Sisson: SnB	Good	Good	Good	Good
Sloan: So	Poor	Poor	Poor	Poor
Spinks:				
SpB	Poor	Fair	Good	Good
SpC	Poor	Fair	Good	Good
StB	Poor	Fair	Good	Good
Thetford: ThA	Poor	Fair	Good	Good
Wallkill: Wa	Very poor	Poor	Poor	Poor
Wasepi: WbA	Fair	Good	Good	Good
Washtenaw: Wd	Fair	Poor	Poor	Poor

nial grasses and herbaceous legumes that are planted to provide food and cover for wildlife. Examples are fescue, timothy, bromegrass, clover, orchardgrass, bluegrass, trefoil, alfalfa, crownvetch, switchgrass, sudangrass, and reed canarygrass.

Wild herbaceous plants are native or naturally established herbaceous grasses and forbs, including weeds, commonly grown on upland areas, that provide food and cover for wildlife. Examples are goldenrod, ragweed, nightshade, strawberry, lambsquarters, dandelions, wintergreen, and native grass.

Hardwood trees are nonconiferous or deciduous trees and associated woody understory plants that provide wildlife cover or produce nuts, buds, catkins, sprouts, twigs, bark, or foliage used as food by wildlife. Examples are maple, beech, oak, poplar, willow, cherry, ash, walnut, elm, and basswood.

Coniferous plants are cone-bearing trees, shrubs, or groundcover that furnish wildlife cover or food in the form of browse, seeds, or fruitlike cones. They may be planted or transplanted or commonly established through natural processes. Included are pine, spruce, fir, cedar, juniper, and yew.

Wetland plants are annual or perennial wild herbaceous plants of moist to wet sites, exclusive of submerged or floating aquatics, that produce food or cover used extensively by wetland wildlife. Examples are smartweed, wild millet, rushes, sedges, reeds, wildrice, cattail, arrowhead, pickerelweed, and water plantain.

Shallow water areas have an average depth of less than 5 feet. They may be natural wet areas or those created by dams or levees or by water control devices in marshes or streams. Examples are muskrat marshes, waterfowl feeding areas, and wildlife ponds.

The ratings shown in table 5 under the heading "Wildlife habitat" apply to wildlife in general and not to a specific species. Not considered, therefore, are present land use, existing vegetation, and the extent of artificial drainage provided, because these factors are subject to change.

A rating of *good* or *fair* indicates that the soil can be managed most practically and with the best chance of success. A rating of *poor* indicates that soil limitations are severe and habitat management may be difficult and expensive and require intensive effort. A rating of *very poor* means that improving, maintaining, or creating habitat under existing soil conditions is impractical. Unsatisfactory results are probable.

Openland wildlife are birds and mammals of cropland, pastures, meadows, lawns, and areas overgrown with grasses, herbs, shrubs, and vines. Examples are bobwhite quail, ring-necked pheasant, meadowlark, field sparrow, killdeer, cottontail rabbit, red fox (fig. 11), and woodchuck.

Woodland wildlife are birds and mammals of wooded areas containing either hardwood or coniferous trees and shrubs, or a mixture of both. Examples are the ruffed grouse, raccoon, white-tailed deer, woodchuck, thrushes, vireos, woodpeckers, tree squirrel, warblers, nuthatches, and owls.

Wetland wildlife are birds and mammals of swampy, marshy, or openwater areas. Examples are ducks, geese, herons, bitterns, rails, kingfishers, cranes, muskrat, and mink.

Recreation

Knowledge of soils is necessary in planning, develop-

habitat—Continued

Elements of habitat—*Continued*			Kinds of habitat		
Coniferous plants	Wetland plants	Shallow water areas	Openland	Woodland	Wetland
Fair	Good	Good	Fair	Fair	Good.
Good	Fair	Fair	Fair	Good	Fair.
Good	Fair	Fair	Fair	Good	Fair.
Poor	Good	Good	Fair	Fair	Good.
Good	Poor	Very poor	Good	Good	Very poor.
Poor	Good	Good	Poor	Poor	Good.
Good	Poor	Very poor	Fair	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Poor	Very poor	Fair	Good	Very poor.
Good	Fair	Fair	Fair	Good	Fair.
Poor	Good	Good	Poor	Poor	Good.
Good	Fair	Fair	Good	Good	Fair.
Poor	Good	Good	Poor	Poor	Good.

ing, and maintaining areas used for recreation. In table 6 the soils of Clinton County are rated according to limitations that affect their suitability for camp areas, playgrounds, picnic areas, and paths and trails.

Limitations are expressed as slight, moderate, or severe. For these ratings, it is assumed that a good cover of vegetation can be established and maintained. A limitation of *slight* means that soil properties are generally favorable and limitations are so minor that they can be easily overcome. A *moderate* limitation can be overcome or modified by planning, by design, or by special maintenance. A limitation of *severe* means that costly soil reclamation, special design, intense maintenance, or a combination of these, is required.

Camp areas are used intensively for tents, small camp trailers, and the accompanying activities of outdoor living. Little preparation of the site is required, other than shaping and leveling for tent and parking areas. Camp areas are subject to heavy foot traffic and limited vehicular traffic. The best soils have mild slopes, good drainage, a surface free of rocks and coarse fragments, no flooding during periods of heavy use, and a surface that is firm after a rain but not dusty when dry.

Playgrounds are areas used intensively for baseball, football, badminton, and similar organized games. Soils suitable for this use need to withstand intensive foot traffic. The best soils have a nearly level surface free of coarse fragments and rock outcrops, good drainage, no flooding during periods of heavy use, and a surface that is firm after a rain but not dusty when dry. If grading and leveling are required, depth to rock is important.

Picnic areas are attractive natural or landscaped tracts subject to heavy foot traffic. Most of the vehicular traffic is confined to access roads. The best soils are firm when wet but not dusty when dry, are free from flooding during the season of use, and do not have slopes or stoniness that greatly increases the cost of leveling sites or of building access roads.

Paths and trails are used for local and cross-country travel by foot or horseback. Design and layout should require little or no cutting and filling. The best soils are at least moderately well drained, are firm when wet but not dusty when dry, are flooded no more than once during the season of use, have slopes of less than 15 percent, and have few or no rocks or stones on the surface.

Engineering[7]

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, soil drainage condition, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, flooding hazard, depth to bedrock, and relief. These properties, in various degrees and combinations, affect construction

[7] KEITH I. BAKEMAN, civil engineer, Soil Conservation Service, helped prepare this section.

Figure 11.—**Red fox in openland area of Oakville soils.**

and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who—

1. Make studies of soil and land use that aid in selecting and developing sites for industrial, commercial, residential, and recreational facilities.
2. Make estimates of engineering properties for use in planning agricultural drainage structures, dams, and other structures for conserving soil and water; in locating suitable routes for underground conduits and cables; and in locating sites for sewage disposal fields.
3. Make preliminary evaluations of soil conditions that will aid in selecting locations for highways, airports, pipelines, and sewage disposal fields, and in planning detailed surveys of the soils at the selected locations.
4. Locate sources of sand, gravel, and other material for use in construction.
5. Correlate pavement performance with the soil mapping units and thus develop information that will be useful in designing and maintaining the pavements.
6. Supplement information obtained from other published maps, reports, and aerial photographs for the purpose of making maps and reports that can be used readily by engineers.
7. Determine suitability of soils for movement of vehicles and construction equipment.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

The engineering interpretations in this soil survey are not intended for use in design. Site investigation, sampling, and testing are needed for a specific engineering work. The estimates reported are to a depth of about 5 feet and normally do not apply to greater depths. Nevertheless, by using this survey, an engineer can select and concentrate on those soil units most important to his proposed construction, and thus reduce the number of soil samples taken for laboratory testing and complete an adequate soil investigation at minimum cost.

The mapping units shown on the maps in this survey may include small areas of different soil materials. These inclusions may be as much as 2 acres in size.

They are too small to be mapped separately and generally are not significant to the farming in the area but may be important in engineering planning.

Information of value in planning engineering work is given throughout the text, particularly in the sections "Descriptions of the Soils" and "Formation and Classification of Soils."

Some terms in soil science may be unfamiliar to engineers. These and other special terms used in the soil survey are defined in the Glossary at the back of this survey. Most of the information about engineering is given in tables 7, 8, and 9.

Engineering classification systems

Agricultural scientists of the United States Department of Agriculture classify soils according to texture. In some ways this system of naming textural classes is comparable to the systems most commonly used by engineers for classifying soils; that is, the system of the American Association of State Highway and Transportation Officials (AASHTO) and the Unified system.

Most highway engineers classify soil material in accordance with the system approved by the American Association of State Highway and Transportation Officials (*1*). In this system soil materials are classified in seven principal groups. The groups range from A–1, gravelly soils, which have high bearing capacity and are the best soils for subgrade, to A–7, clayey soils, which have low strength when wet and are the poorest soils for subgrade.

Some engineers prefer to use the Unified Soil Classification System (*2*). In this system soil material is identified according to its grain size distribution, plasticity, and performance as construction material. Soil materials are identified as coarse grained (GW, GP, GM, GC, SW, SP, and SC), fine grained (ML, CL, OL, MH, CH, and OH), and highly organic (Pt).

Soil properties significant in engineering

In table 7 the soil series and the symbols for most mapping units are listed and estimates of properties significant in engineering are given. The estimated properties are those of the representative soil. Where test data are available, that information was used. Where tests were not performed, the estimates shown are based on comparisons of the soil in Clinton County with similar soils tested in other counties.

Depth to the seasonal high water table is the maximum height to which the water table rises during the year. The estimates are for soil material that has not been artificially drained. In general, the information in the table applies to a depth of 5 feet or less. Depth from the surface normally is given only for the major horizons. Other horizons are listed if they have engineering properties significantly different from adjacent horizons.

The estimated classification according to the textural classification of the U.S. Department of Agriculture and according to the AASHTO and Unified classification systems is given for each important layer. The figures showing the percentages of material passing through sieves numbers 4, 10, 40, and 200 are rounded off to the nearest 5 percent. The percentage passing the number 200 sieve approximates the combined amount of silt and clay in the soil.

Liquid limit and plasticity index are water contents obtained by specified operations. As the water content of a clayey soil, from which the particles coarser than 0.42 millimeter have been removed, is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from a semisolid to a plastic state; and the liquid limit, from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of water content within which a soil material is plastic. Liquid limit and plasticity index are estimated in table 7.

In the column "Permeability" are estimates of the rate at which water moves downward through saturated undisturbed soil material. The estimates are based mainly on texture, structure, and consistence of the soils.

Available water capacity, expressed in inches per inch of soil depth, is defined in the Glossary. Reaction also is defined in the Glossary. Shrink-swell potential refers to the change in volume of the soil that results from a change in moisture content. The estimates are based mainly on the amount and kind of clay in the soil.

The soils are also rated in table 7 according to the risk of corrosion of conduits placed in them. Ratings are given for uncoated steel conduits and concrete conduits. The texture and natural drainage of a soil affect this potential through their influence on aeration, water content, and movement of water. The pH of the soil also may be important.

Engineering interpretations

Engineering interpretations are given in tables 8 and 9. The data in these tables applies to the representative profile described for the soil series in the section "Descriptions of the Soils." The interpretations are based on the engineering properties of soils shown in table 7, on test data for soils in this survey area and other nearby or adjoining areas, and on the experience of engineers and soil scientists with the soils of Clinton County.

Table 9 lists the suitability rating of the soils as a source of roadfill, sand and gravel, and topsoil. Suitability is rated as good, fair, poor, and unsuited. The major soil feature affecting the suitability is also listed. Table 9 also lists the soil features that should not be overlooked in planning, installing, and maintaining pond reservoirs, embankments, dikes and levees, excavated ponds, drainage, irrigation, terraces and diversions, and grassed waterways.

Roadfill is soil material used in embankments for roads. The suitability ratings reflect the predicted performance of a soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and the relative ease of excavating the material at borrow areas.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 9 provide information on where to look for probable sources. A soil rated as a *good* or *fair* source of sand or gravel

TABLE 6.—*Limitations for recreational facilities*

Soil name and map symbol	Camp areas	Playgrounds	Picnic areas	
Ad—Adrian muck	Severe: wetness; excess humus.	Severe: wetness; excess humus.	Severe: wetness; excess humus.	Se
BdA—Blount loam, 0 to 2 percent slopes	Moderate: wetness	Moderate: wetness	Moderate: wetness	M
BdB—Blount loam, 2 to 6 percent slopes	Moderate: wetness	Moderate: wetness; slope.	Moderate: wetness	M
BnB—Boyer sandy loam, 0 to 6 percent slopes.	Slight	Moderate: slope	Slight	Sli
BnC—Boyer sandy loam, 6 to 12 percent slopes.	Moderate: slope	Severe: slope	Moderate: slope	Sli
BoB—Boyer complex, 0 to 6 percent slopes.	Moderate: too sandy	Moderate: too sandy; slope.	Moderate: too sandy	M
BoC—Boyer complex, 6 to 12 percent slopes.	Moderate: too sandy	Severe: slope	Moderate: too sandy	M
BoD—Boyer complex, 12 to 18 percent slopes.	Severe: slope	Severe: slope	Severe: slope	M
BoE—Boyer complex, 18 to 25 percent slopes.	Severe: slope	Severe: slope	Severe: slope	M
CaA—Capac loam, 0 to 4 percent slopes	Severe: wetness	Severe: wetness	Moderate: wetness	M
CbB—Capac-Marlette loams, 1 to 6 percent slopes. For Marlette part of CbB, see MaB in Marlette series.	Severe: wetness	Severe: wetness	Moderate: wetness	M
Ce—Ceresco fine sandy loam	Severe: floods; wetness	Severe: wetness	Moderate: wetness	M
Ch—Cohoctah loam	Severe: wetness; floods	Severe: wetness; floods	Severe: wetness; floods	Se
Co—Colwood loam	Severe: wetness	Severe: wetness	Severe: wetness	Se
Cr—Corunna sandy loam	Severe: wetness	Severe: wetness	Severe: wetness	Se
Ed—Edwards muck	Severe: wetness; excess humus; dusty.	Severe: wetness; excess humus; dusty.	Severe: wetness; excess humus; dusty.	Se
Gf—Gilford sandy loam	Severe: wetness	Severe: wetness	Severe: wetness	Se
Gr—Granby loamy sand	Severe: wetness	Severe: wetness	Severe: wetness	Se
Ho—Houghton muck	Severe: wetness; excess humus.	Severe: wetness; excess humus	Severe: wetness; excess humus.	Se
KbA—Kibbie loam, 0 to 3 percent slopes	Severe: wetness	Severe: wetness	Moderate: wetness	M
LaB—Lapeer sandy loam, 2 to 6 percent slopes.	Slight	Moderate: slope	Slight	Sl
MaB—Marlette loam, 2 to 6 percent slopes.	Slight	Moderate: slope	Slight	Sl

MaC—Marlette loam, 6 to 12 percent slopes.	Moderate: slope	Severe: slope	Moderate: slope	Sli
MaD—Marlette loam, 12 to 18 percent slopes.	Severe: slope	Severe: slope	Severe: slope	M
MaE—Marlette loam, 18 to 25 percent slopes.	Severe: slope	Severe: slope	Severe: slope	M
MbC3—Marlette clay loam, 6 to 12 percent slopes, severely eroded.	Moderate: slope; too clayey.	Severe: slope	Moderate: slope; too clayey.	M
MbD3—Marlette clay loam, 12 to 18 percent slopes, severely eroded.	Severe: slope	Severe: slope	Severe: slope	M
MdA—Matherton loam, 0 to 3 percent slopes.	Severe: wetness	Severe: wetness	Moderate: wetness	M
MeA—Metamora-Capac sandy loams, 0 to 4 percent slopes. For Capac part of MeA, see CaA in Capac series.	Severe: wetness	Severe: wetness; slope	Moderate: wetness	M
MhB—Metea loamy sand, 2 to 6 percent slopes.	Moderate: too sandy	Moderate: too sandy	Moderate: too sandy	M
MoB—Morley loam, 2 to 6 percent slopes.	Moderate: percs slowly	Moderate: slope; percs slowly.	Slight	Sl
MoC—Morley loam, 6 to 12 percent slopes.	Moderate: percs slowly	Severe: slope	Moderate: slope	Sl
OaB—Oakville fine sand, 0 to 6 percent slopes.	Moderate: too sandy	Severe: too sandy	Moderate: too sandy	M
OsB—Oshtemo sandy loam, 2 to 6 percent slopes.	Slight	Moderate: slope	Slight	Sl
OtA—Owosso sandy loam, 0 to 2 percent slopes.	Slight	Slight	Slight	Sl
OwB—Owosso-Marlette sandy loams, 2 to 6 percent slopes. For Marlette part of OwB, see MaB in Marlette series.	Slight	Moderate: slope	Slight	Sl
OwC—Owosso-Marlette sandy loams, 6 to 12 percent slopes. For Marlette part of OwC, see MaC in Marlette series.	Moderate: slope	Severe: slope	Moderate: slope	Sl
Pa—Palms muck	Severe: wetness; excess humus.	Severe: wetness; excess humus.	Severe: wetness; excess humus.	Se
Pr—Parkhill loam	Severe: wetness	Severe: wetness	Severe: wetness	Se
Sb—Sebewa loam	Severe: wetness	Severe: wetness	Severe: wetness	Se
SeA—Selfridge loamy sand, 0 to 4 percent slopes.	Moderate: too sandy; wetness.	Moderate: too sandy; wetness.	Moderate: too sandy; wetness.	M
Sh—Shoals loam	Severe: floods	Severe: floods	Moderate: wetness	M
Sm—Sims silty clay loam	Severe: wetness	Severe: wetness	Severe: wetness	Se

TABLE 6.—*Limitations for recreational facilities*—Continued

Soil name and map symbol	Camp areas	Playgrounds	Picnic areas	
SnB—Sisson fine sandy loam, 2 to 6 percent slopes.	Slight	Moderate: slope	Slight	Sli
So—Sloan loam	Severe: wetness; floods	Severe: wetness; floods	Severe: wetness; floods	Se
SpB—Spinks loamy sand, 0 to 6 percent slopes.	Moderate: too sandy	Moderate: too sandy	Moderate: too sandy	M
SpC—Spinks loamy sand, 6 to 12 percent slopes.	Moderate: too sandy	Severe: slope	Moderate: too sandy	M
StB—Spinks cobbly loamy sand, cobbly variant, 0 to 6 percent slopes.	Severe: small stones	Severe: small stones; too sandy; soil blowing.	Severe: small stones	Se
ThA—Thetford loamy sand, 0 to 3 percent slopes.	Severe: too sandy; wetness.	Severe: too sandy; wetness.	Moderate: too sandy; wetness.	M
Wa—Wallkill loam	Severe: wetness; flooding.	Severe: wetness; flooding.	Severe: wetness; flooding.	Se
WbA—Wasepi sandy loam, 0 to 3 percent slopes.	Severe: wetness	Severe: wetness	Moderate: wetness	M
Wd—Washtenaw loam	Severe: wetness; floods	Severe: wetness; floods	Severe: wetness; floods	Se

generally has a layer at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the material. Neither do they indicate quality of the deposit.

Topsoil is used in topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material, as in preparing a seedbed; the natural fertility of the material or the response of plants when fertilizer is applied; and the absence of substances toxic to plants. Texture of the soil material and its content of stone fragments affect suitability, but also considered in the ratings is damage that results at the area from which topsoil is taken.

Pond reservoirs hold water behind a dam or an embankment. Soils suitable as pond reservoir areas have low seepage, which is related to permeability and the depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Stones and organic material are unfavorable characteristics.

Excavated ponds, aquifer fed, are dug ponds that rely on ground water as their source. Soil properties affecting excavated ponds are the reliability of ground water recharge and its level, the stability of soil, the organic-matter content, and the presence of stones and rock outcrop.

Drainage of cropland and pasture is affected by such soil properties as the permeability, texture, and structure; the depth to a claypan, rock, or other layer that influences the rate of water movement; the depth to the water table; the slope, stability in ditchbanks, and susceptibility to stream overflow; the reaction; and the availability of drainage outlets.

Irrigation of a soil is affected by such features as slope, susceptibility to stream overflow, water erosion or soil blowing, texture, content of stones, accumulation of salts and alkali, depth of rooting zone, rate of water intake at the surface, permeability of soil below the surface layer and in the fragipan or other layers that restrict movement of water, available water capacity; and need for drainage or depth to water table or bedrock.

Terraces and diversions are embankments, or ridges, constructed across slopes to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope, depth to bedrock or other unfavorable material, stoniness, permeability, and resistance to water erosion, soil slippage, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

The success of grassed waterways depends on soil features that affect the construction and maintenance of the waterways and the growth of plants within them. Important features are available water capacity, permeability, slope, stoniness, rate of runoff and susceptibility to erosion, and natural drainage. Establishing a dense sod that is resistant to erosion is needed for well-constructed waterways.

Table 8 lists the degree and kind of limitation for selected uses. Soil limitations are indicated by the ratings slight, moderate, and severe. *Slight* means that soil properties are generally favorable for the rated use, or that limitations are minor and are easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* indicates soil properties so unfavorable and so difficult to correct or overcome that major soil reclamation, special designs, or intensive maintenance is needed.

Following are explanations of some of the columns in table 8:

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material from a depth of 18 inches to 6 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to the water table or to rock, and susceptibility to flooding. Slope is a soil property that affects difficulty of layout and construction and also the risk of soil erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet long enough for bacteria to decompose the solids. A lagoon has a nearly level floor and sides, or embankments, of compacted soil material. It is assumed that the embankment is compacted to medium density and the pond is protected from flooding. Properties that affect the pond floor and the embankment are considered. Those that affect the pond floor are permeability, organic matter, and slope. The soil properties that affect the embankment are the engineering properties of the embankment material as interpreted from the Unified Soil Classification and the content of stones, if any, that influence the ease of excavation and compaction of the embankment material.

Trench type sanitary landfill is a method of disposing of refuse in dug trenches. The waste is spread in thin layers, compacted, and covered with soil throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, hazard of polluting ground water, and trafficability. The best soils have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated, the ratings in table 8 apply only to a depth of about 5 feet. Limitation ratings of *slight* or *moderate,* therefore, may not be valid if trenches are to be much deeper. For some soils, reliable predictions can be made to a depth of 10 or 15 feet; however, every site should be investigated before it is selected. Daily cover for area type landfill relies on texture, consistence, thickness, stoniness, slope, and drainage of the material.

In the area type of sanitary landfill, refuse is placed on the surface of the soil in successive layers. The limitations caused by texture and stoniness do not apply to this type of landfill. Soil wetness, however, may be a limitation because of difficulty in operating equipment.

TABLE 7.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit is made up of two or more kinds of soil. The soils in such first column of this table carefully. Absence of data indicates that the soil is too variable to be

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	USDA texture	Classification		Coarse fraction greater than 3 inches
				Unified	AASHTO	
	Feet	*Inches*				*Percent*
Adrian: Ad	0–1	0–25	Muck (sapric)	Pt		
		25–60	Sand	SP or SM	A–3	
Blount: BdA, BdB	1–3	0–9	Loam	ML	A–4	
		9–16	Clay loam	CL	A–6	
		16–31	Silty clay and silty clay loam.	CL	A–6 or A–7	
		31–60	Silty clay loam	CL	A–7	
Borrow land: Bh. Too variable to be rated.						
Boyer: BnB, BnC, BoB, BoC, BoD, BoE	>6	0–18	Loamy sand	SM	A–2	
		18–30	Sandy loam	SM	A–2	
		30–34	Sandy clay loam	SC or SM	A–2, A–6	
		34–60	Gravel and sand	SP, SP-SM, GP	A–1 or A–3	
*Capac: CaA, CbB For Marlette part of unit CbB, see Marlette series.	1–2	0–9	Loam	ML or CL	A–4	
		9–31	Clay loam	CL	A–6	
		31–60	Loam	ML or CL	A–4 or A–6	
Ceresco: Ce	1–2	0–19	Sandy loam and fine sandy loam.	SM, ML	A–2 or A–4	
		19–26	Loamy fine sand	SM	A–2	
		26–60	Sandy loam	SM	A–2, A–4	
Cohoctah: Ch	0–1	0–25	Loam and fine sandy loam.	ML or CL	A–4	
		25–29	Loamy sand	SM	A–2	
		29–60	Sandy loam	SM	A–2 or A–4	
Colwood: Co	0–1	0–22	Loam and silt loam	ML or CL	A–4	
		22–34	Silty clay loam	CL	A–6	
		34–60	Silt loam	CL	A–6	
Corunna: Cr	0–1	0–22	Sandy loam	SM	A–2, A–4	
		22–38	Heavy sandy loam	SM	A–2 or A–4	
		38–60	Light sandy loam	CL	A–6	
Edwards: Ed	0–1	0–26	Muck (sapric)	Pt		
		26–60	Marl			
Gilford: Gf	0–1	0–28	Sandy loam	SM	A–2	
		28–60	Sand and gravel	SP or GP	A–1 or A–3	
Granby: Gr	0–1	0–14	Loamy sand	SM	A–2	
		14–22	Sand	SM	A–3	
		22–26	Loamy sand	SM	A–2	
		26–60	Sand	SM	A–3	
Houghton: Ho	0–1	0–60	Muck (sapric)	Pt		
Kibbie: KbA	1.5–2.0	0–10	Loam	ML or CL	A–4	
		10–19	Light silty clay loam.	CL	A–6	
		19–60	Silt loam	ML	A–4	
Lapeer: LaB	>6	0–25	Sandy loam	SM or SM–SC	A–2 or A–4	
		25–34	Heavy sandy loam	SC	A–6	
		34–60	Sandy loam	SM or SM–SC	A–2 or A–4	

significant in engineering

mapping units may have different properties and limitations, and for this reason it is necessary to follow the instructions in the rated or that no estimate was made. The symbol > means greater than; the symbol < means less than]

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Risk of corrosion	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Percent		*Inches per hour*	*Inches per inch of soil*	*pH*			
						0.2–6.0	0.35–0.45	5.6–6.0	High	High	Low.
100	90–100	50–70	0–15		[1] NP	6.0–20	0.05–0.08	7.9–8.4	Low	High	Low.
95–100	90–100	80–95	60–75	25–38	4–10	0.6–2.0	0.22–0.24	6.6–7.3	Low	Moderate	Low.
95–100	90–100	90–100	70–80	30–40	13–22	0.2–0.6	0.16–0.18	6.1–6.5	Moderate	High	Low.
95–100	90–100	95–100	85–95	40–49	20–26	0.06–0.2	0.15–0.19	6.1–7.3	Moderate	High	Low.
95–100	90–100	90–100	80–95	30–40	13–22	0.2–0.6	0.18–0.20	7.4–7.8	Moderate	High	Low.
95–100	90–95	50–75	15–30	10–20	NP–6	6.0–20	0.10–0.12	5.6–6.5	Low	Low	Moderate.
90–100	80–95	55–70	20–35	15–25	2–7	2.0–6.0	0.10–0.14	6.1–6.5	Low	Low	Moderate.
95–100	80–90	65–75	30–40	15–25	2–16	2.0–6.0	0.14–0.18	6.6–7.3	Low	Low	Moderate.
55–90	50–80	40–60	0–10		NP	>20	0.02–0.04	7.9–8.4	Low	Low	Low.
100	90–100	85–95	60–75	20–30	5–10	0.6–2.0	0.20–0.22	5.6–6.1	Low	High	Moderate.
95–100	90–100	90–100	70–80	30–40	13–20	0.2–2.0	0.15–0.19	5.6–7.3	Low	High	Low.
90–100	90–100	85–95	60–75	20–30	5–12	0.6–2.0	0.15–0.19	7.9–8.4	Low	High	Low.
100	100	60–80	30–55	10–25	2–6	2.0–6.0	0.13–0.17	6.6–7.3	Low	Low	Low.
100	100	55–70	10–35	10–20	NP–5	6.0–20	0.09–0.11	7.4–7.8	Low	Low	Low.
100	100	60–70	30–40	10–20	2–6	0.6–6.0	0.11–0.13	7.9–8.4	Low	Low	Low.
100	100	70–90	50–65	15–28	3–10	0.6–6.0	0.17–0.19	6.6–7.3	Low	High	Low.
100	100	60–70	15–30	5–15	NP–4	6.0–20	0.09–0.11	6.6–7.3	Low	High	Low.
100	100	60–70	30–40	10–20	2–6	2.0–6.0	0.14–0.16	7.4–7.8	Low	High	Low.
100	100	90–100	70–80	25–35	3–10	0.6–2.0	0.20–0.24	6.6–7.3	Low	High	Low.
100	100	90–100	70–85	30–35	10–20	0.6–2.0	0.18–0.20	6.6–7.3	Low	High	Low.
100	100	90–100	70–90	25–35	3–10	0.6–2.0	0.20–0.22	7.9–8.4	Low	High	Low.
100	100	65–75	25–40	15–25	NP–6	0.6–2.0	0.13–0.15	6.6–7.3	Low	High	Low.
100	100	65–75	30–45	20–30	2–7	0.6–2.0	0.12–0.14	6.6–7.3	Low	High	Low.
100	95–100	90–100	78–85	30–40	13–20	0.2–0.6	0.15–0.17	7.9–8.4	Moderate	High	Low.
						0.2–6.0	0.35–0.45	6.1–7.8	High	High	Low.
100	100	80–90	60–80					7.9–8.4	High	High	Low.
95–100	90–100	55–75	20–35	12–25	2–6	2.0–6.0	0.13–0.14	6.6–7.3	Low	High	Low.
35–80	25–75	50–70	0–5		NP	6.0–20	0.02–0.04	6.6–8.4	Low	High	Low.
100	100	50–75	15–30		NP	6.0–20	0.10–0.12	6.6–7.3	Low	High	Low.
100	100	50–70	5–15		NP	6.0–20	0.06–0.08	6.6–7.3	Low	High	Low.
100	100	50–70	15–25		NP	6.0–20	0.09–0.12	6.6–7.3	Low	High	Low.
100	95–100	50–70	5–15		NP	6.0–20	0.05–0.07	7.9–8.4	Low	High	Low.
						0.2–6.0	0.35–0.45	6.6–7.3	High	High	Low.
100	100	85–95	60–75	20–30	5–12	0.6–2.0	0.20–0.22	5.6–7.3	Low	High	Moderate.
100	100	90–100	70–85	30–35	12–20	0.6–2.0	0.18–0.20	5.6–6.0	Low	High	Moderate.
100	100	90–100	70–90	25–35	3–10	0.6–2.0	0.20–0.22	6.6–8.4	Low	High	Low.
95–100	95–100	60–75	20–45	12–29	2–8	2.0–6.0	0.13–0.15	5.6–6.0	Low	Low	Moderate.
95–100	90–100	75–85	36–45	25–30	12–16	0.6–2.0	0.16–0.18	6.1–6.5	Low	Low	Moderate.
95–100	80–95	55–75	25–50	15–23	3–6	2.0–6.0	0.12–0.15	7.4–8.4	Low	Low	Low.

TABLE 7.—*Estimated soil properties*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	USDA texture	Classification		Coarse fraction greater than 3 inches
				Unified	AASHTO	
	Feet	*Inches*				*Percent*
Marlette: MaB, MaC, MaD, MaE, MbC3, MbD3.	2.5–>6	0–14	Loam	ML or CL	A–4	
		14–20	Clay loam and loam	CL or ML	A–6 or A–4	
		20–38	Clay loam	CL	A–6	
		38–60	Light clay loam	ML or CL	A–4 or A–6	
Matherton: MdA	1.0–2.0	0–13	Loam and sandy loam.	ML, SM	A–2, A–4	
		13–32	Sandy clay loam and loam.	SC, CL	A–6, A–4	
		32–60	Sand and gravel	GP, SP, SP–SM	A–1, A–3	
*Metamora: MeA For Capac part, see Capac series.	1.0–2.0	0–25	Sandy loam and loamy sand.	SM	A–2, A–4	
		25–32	Heavy sandy loam	SM or SC	A–4	
		32–40	Light clay loam	CL or ML	A–6 or A–4	
		40–60	Loam	ML or CL	A–4 or A–6	
Metea: MhB	>6	0–36	Loamy sand	SM	A–2	
		36–60	Clay loam	CL	A–6	
Morley: MoB, MoC	2.5–>6	0–18	Loam	ML or CL	A–4	
		18–26	Silty clay loam	CL	A–7	
		26–40	Heavy silty clay loam.	CL	A–7	
		40–60	Silty clay loam	CL	A–7 or A–6	
Oakville: OaB	>5	0–60	Fine sand	SM	A–2	
Oshtemo: OsB	>6	0–14	Sandy loam	SM, SC–SM	A–2	
		14–26	Heavy sandy loam	SM, SC–SM	A–2 or A–4	
		26–41	Light sandy loam	SM	A–2	
		41–55	Loamy sand	SM	A–2	
		55–60	Gravel and sand	SP, SP–SM, GP	A–1 or A–3	
*Owosso: OtA, OwB, OwC For Marlette part of OwB and OwC, see Marlette series.	>6	0–23	Sandy loam	SM or SM–SC	A–2	
		23–26	Heavy sandy loam	SC–SM	A–4	
		26–34	Clay loam	CL	A–6	
		34–60	Heavy loam	CL or CL–ML	A–4 or A–6	
Palms: Pa	0–1	0–41	Muck (sapric)	Pt		
		41–60	Silt loam	CL–ML	A–4	
Parkhill: Pr	0–1	0–22	Loam	ML	A–4	
		22–30	Clay loam	CL	A–6	
		30–60	Loam	ML or CL	A–4 or A–6	
Sebewa: Sb	0–1	0–18	Loam	ML	A–4	
		18–39	Light clay loam and gravelly clay loam.	CL	A–6	
		39–60	Sand and gravel	SP or GP	A–1 or A–3	
Selfridge: SeA	1.0–2.0	0–22	Loamy sand	SM	A–2	
		22–27	Sandy loam	SM	A–2	
		27–34	Light clay loam	CL	A–6	
		34–60	Loam	CL	A–6	
Shoals: Sh	1–2.5	0–19	Loam	ML	A–4	
		19–38	Light silty clay loam.	CL	A–6	
		38–51	Loam	ML	A–4	
		51–60	Fine sandy loam and silt loam.	SM–ML	A–4	
Sims: Sm	0–1	0–14	Light silty clay loam	CL	A–6	
		14–24	Clay loam	CL	A–6	
		24–36	Light clay loam	CL	A–6	
		36–60	Silty clay loam	CL	A–7	

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Risk of corrosion	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Percent		*Inches per hour*	*Inches per inch of soil*	*pH*			
100	95–100	80–95	60–70	16–30	3–10	0.6–2.0	0.20–0.22	5.6–6.0	Low	Moderate	Moderate.
95–100	90–100	85–95	60–80	24–38	6–20	0.2–2.0	0.15–0.19	5.6–6.0	Low	Moderate	Moderate.
95–100	90–100	80–100	65–90	25–35	8–20	0.2–2.0	0.16–0.20	5.6–6.5	Low	Moderate	Low.
95–100	90–100	85–95	65–80	24–35	6–20	0.6–2.0	0.15–0.19	7.9–8.4	Low	Moderate	Low.
95–100	90–100	65–90	30–65	15–25	3–8	2.0–6.0	0.18–0.20	6.1–6.5	Low	High	Moderate.
95–100	85–95	75–90	35–75	25–40	10–20	0.6–2.0	0.16–0.18	6.6–7.3	Low	High	Moderate.
40–80	35–70	15–45	0–10		NP	6.0–20	0.02–0.04	7.9–8.4	Low	High	Low.
95–100	95–100	50–75	20–40	<20	NP–6	2.0–6.0	0.13–0.15	5.1–6.5	Low	Moderate	Moderate.
95–100	90–95	65–85	36–50	15–30	5–9	2.0–6.0	0.15–0.17	6.6–7.3	Low	Moderate	Low.
95–100	90–100	85–95	60–80	24–35	6–20	0.2–0.6	0.15–0.19	7.4–7.8	Moderate	High	Low.
100	95–100	80–95	60–75	16–30	6–14	0.6–2.0	0.16–0.18	7.9–8.4	Low	High	Low.
100	100	55–60	15–25		NP	>20	0.10–0.12	5.6–7.3	Low	Low	Moderate.
100	90–95	80–95	65–75	33–40	15–22	0.2–2.0	0.14–0.16	6.6–8.4	Moderate	Moderate	Low.
95–100	95–100	80–95	60–70	16–30	3–10	0.6–2.0	0.18–0.20	5.1–6.5	Low	Moderate	Moderate.
95–100	95–100	95–100	85–95	30–40	13–22	0.2–0.6	0.18–0.20	5.1–5.5	Moderate	Moderate	Moderate.
95–100	95–100	95–100	85–95	40–49	20–26	0.06–0.6	0.16–0.19	5.6–6.5	Moderate	High	Moderate.
95–100	95–100	90–95	80–95	30–40	13–21	0.2–0.6	0.18–0.20	6.6–8.4	Moderate	Moderate	Low.
100	100	70–80	20–35		NP	6.0–>20	0.06–0.08	6.1–7.3	Low	Low	Low.
95–100	90–95	55–65	25–35	12–25	2–6	2.0–6.0	0.13–0.15	6.1–6.5	Low	Low	Moderate.
95–100	90–95	65–70	30–40	20–30	2–7	2.0–6.0	0.12–0.14	5.1–5.5	Low	Low	High.
95–100	90–95	50–60	20–35	12–20	NP–4	2.0–6.0	0.11–0.13	5.1–5.5	Low	Low	High.
85–95	80–95	55–70	10–15		NP	6.0–20	0.06–0.08	6.1–6.5	Low	Low	Moderate.
55–90	50–80	40–60	0–10		NP	>20	0.02–0.04	7.9–8.4	Low	Low	Low.
100	90–100	55–70	20–35	12–30	2–6	2.0–6.0	0.13–0.15	6.1–6.5	Low	Low	Moderate.
100	95–100	65–70	35–40	15–25	3–8	0.6–2.0	0.15–0.17	6.1–6.5	Low	Low	Moderate.
95–100	90–95	85–95	75–85	30–40	12–22	0.2–0.6	0.15–0.19	6.1–6.5	Moderate	Moderate	Low.
95–100	90–100	85–90	65–75	15–35	6–14	0.2–0.6	0.15–0.18	6.6–7.8	Moderate	Moderate	Low.
						0.2–6.0	0.35–0.45	6.1–7.3	High	High	Moderate.
100	100	90–100	70–80	15–30	5–10	0.6–2.0	0.16–0.20	7.4–8.4	Low	High	Low.
100	95–100	85–95	60–75	23–37	4–9	0.6–2.0	0.20–0.22	6.6–7.3	Low	High	Low.
95–100	90–100	85–95	70–85	30–40	12–20	0.2–0.6	0.15–0.19	6.6–7.3	Low	High	Low.
95–100	90–100	85–90	65–75	15–35	6–14	0.6–2.0	0.17–0.19	7.4–7.8	Low	High	Low.
100	90–100	80–95	60–70	20–35	4–10	0.6–2.0	0.20–0.22	6.6–7.3	Low	High	Low.
95–100	75–100	85–90	60–80	30–35	12–20	0.6–2.0	0.16–0.19	6.6–7.3	Low	High	Low.
40–75	35–70	30–40	0–10		NP	6.0–20	0.02–0.04	7.4–8.4	Low	High	Low.
100	100	50–75	15–30		NP	6.0–20	0.10–0.12	5.6–6.5	Low	Low	Moderate.
95–100	95–100	70–80	25–35	15–30	2–4	6.0–20	0.12–0.14	5.6–6.0	Low	Low	Moderate.
95–100	90–100	90–100	70–80	30–40	13–20	0.2–0.6	0.15–0.19	6.6–7.3	Moderate	High	Low.
95–100	90–100	80–90	60–75	15–35	11–14	0.6–2.0	0.17–0.19	7.4–7.8	Moderate	Moderate	Low.
100	100	85–95	60–75	25–35	6–10	0.6–2.0	0.20–0.22	6.6–7.3	Low	High	Low.
100	100	95–100	80–95	30–35	12–20	0.6–2.0	0.18–0.20	6.6–7.3	Low	High	Low.
100	100	85–95	60–75	25–35	6–10	0.6–2.0	0.17–0.19	7.4–7.8	Low	High	Low.
100	100	75–95	40–80	<25	NP–4	0.6–2.0	0.17–0.21	7.4–7.8	Low	High	Low.
100	95–100	95–100	80–95	28–38	11–22	0.6–2.0	0.21–0.23	6.6–7.3	Moderate	High	Low.
95–100	90–100	85–95	70–85	30–40	13–22	0.06–0.2	0.15–0.19	6.6–7.3	Moderate	High	Low.
100	90–100	90–100	70–85	30–40	10–20	0.06–0.2	0.16–0.18	6.6–7.3	Moderate	High	Low.
100	90–100	90–100	80–95	30–40	13–22	0.06–0.2	0.18–0.20	6.6–7.8	Moderate	High	Low.

TABLE 7.—*Estimated soil properties*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	USDA texture	Classification		Coarse fraction greater than 3 inches
				Unified	AASHTO	
	Feet	*Inches*				*Percent*
Sisson: SnB	>6	0–23	Fine sandy loam	SM or ML	A–4	
		23–38	Light silty clay loam.	CL	A–6	
		38–42	Silt loam	ML	A–4	
		42–60	Silt, fine sand, and very fine sand.	ML or SM	A–4 or A–2	
Sloan: So	.0–0.5	0–10	Loam	ML	A–4	
		10–40	Silt loam	ML	A–4	
		40–60	Silt loam, sandy loam, and silty clay loam.	ML or CL	A–4, A–6	
Spinks: SpB, SpC	>6	0–19	Loamy sand and sand.	SM or SP–SM	A–2, A–3	
		19–54	Sand, loamy sand, and sandy loam.	SM or SP–SM	A–2	
		54–60	Sand	SM–SP or SP	A–3	
Spinks variant: StB	>6	0–24	Cobbly loamy sand	SM	A–2	35–60
		24–48	Cobbly sand and sandy loam.	SP, SM or SM–SP	A–1, A–2, or A–3	35–60
		48–60	Cobbly sand	SP or SP–SM	A–1, A–2, or A–3	35–55
Thetford: ThA	1–2	0–28	Loamy sand	SM	A–2	
		28–34	Sandy loam	SM	A–2	
		34–60	Sand	SP or SP–SM	A–3	
Wallkill: Wa	.0–0.5	0–19	Loam and silt loam	ML	A–4	
		19–60	Muck and mucky peat (sapric and hemic).	Pt		
Wasepi: WbA	1.5–2.0	0–26	Sandy loam	SM	A–2	
		26–33	Heavy sandy loam	SM	A–2 or A–4	
		33–60	Sand and gravel	SP or GP	A–1 or A–3	
Washtenaw: Wd	0–1	0–29	Loam	ML	A–4	
		29–37	Clay loam	CL	A–6	
		37–60	Loam	ML or CL	A–4 or A–6	

[1] Nonplastic.

Daily cover for sanitary landfill should be soil that is easy to excavate and spread over the compacted fill during both wet and dry periods. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread. Sandy soils may be subject to soil blowing.

Small commercial buildings are built on undisturbed soil. Structures should be sufficiently stable that cracking or subsidence from settling or shear failure of the foundation does not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity, in-place density, potential frost action, soil wetness, and depth to high water table were also considered. Slope, also an important consideration in the choice of sites for these structures, was considered in determining the ratings. Susceptibility to flooding is a serious limitation.

Shallow excavations are those that require digging or trenching to a depth of less than 6 feet. Examples include excavation for pipelines, sewer lines, phone and power transmission lines, basements, open ditches, and cemeteries. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrop or large stones, no flooding, and no high water table.

Dwellings as rated in table 8, are no more than three stories high and are supported by footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to capacity to

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Risk of corrosion	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Percent		*Inches per hour*	*Inches per inch of soil*	*pH*			
100	100	70–85	40–55	18–30	4–9	2.0–6.0	0.16–0.18	6.1–7.3	Low	Low	Low.
100	100	95–100	85–90	30–40	10–22	0.6–2.0	0.18–0.20	6.1–6.5	Low	Low	Low.
100	100	90–100	70–90	25–35	3–10	0.5–2.0	0.20–0.22	7.4–7.8	Low	Low	Low.
100	100	70–95	30–75	25–35	3–10	0.6–2.0	0.17–0.19	7.9–8.4	Low	Low	Low.
100	100	85–95	70–80	25–35	6–10	0.6–2.0	0.20–0.22	6.6–7.3	Low	High	Low.
100	100	90–100	70–90	25–35	5–10	0.6–2.0	0.20–0.22	6.6–7.8	Low	High	Low.
100	100	80–95	65–90	25–40	6–15	0.6–2.0	0.16–0.19	7.4–7.8	Low	High	Low.
100	95–100	50–70	5–20		NP	6.0–20	0.07–0.10	5.6–6.5	Low	Low	Moderate.
100	95–100	50–75	10–25		NP	2.0–20	0.07–0.12	6.1–7.3	Low	Low	Moderate.
95–100	90–100	50–70	5–10		NP	6.0–20	0.04–0.06	7.4–7.8	Low	Low	Low.
70–100	55–95	45–75	15–25		NP	6.0–20	0.04–0.06	6.1–7.3	Low	Low	Low.
60–100	55–90	40–80	0–30	<30	NP–10	6.0–20	0.02–0.08	6.6–7.3	Low	Low	Low.
51–100	40–95	0–70	0–10		NP	6.0–20	0.02–0.04	7.4–7.8	Low	Low	Low.
100	100	50–75	15–30	>10	NP–4	6.0–20	0.10–0.12	5.6–6.5	Low	Low	Moderate.
95–100	95–100	60–70	25–35	15–30	2–6	2.0–6.0	0.10–0.13	6.1–6.5	Low	Low	Moderate.
95–100	90–100	50–70	0–10		NP	6.0–20	0.05–0.07	6.6–7.3	Low	Low	Low.
95–100	90–100	75–100	55–90	10–20	2–4	0.6–2.0	0.20–0.23	5.6–6.0	Low	Moderate	Moderate.
						0.2–6.0	0.35–0.55	6.1–6.5	High	Moderate	Moderate.
95–100	85–95	60–75	20–30	12–22	2–6	2.0–6.0	0.13–0.15	6.1–6.5	Low	Low	Moderate.
90–100	85–95	65–70	30–40	20–30	2–7	2.0–6.0	0.15–0.17	6.1–6.5	Low	Low	Moderate.
35–100	25–95	30–60	0–10		NP	>20	0.02–0.04	6.6–7.8	Low	Low	Low.
100	95–100	85–95	60–75	23–37	4–9	0.6–2.0	0.18–0.22	6.1–7.3	Low	High	Low.
95–100	90–100	85–95	70–85	30–40	12–20	0.06–0.6	0.15–0.19	6.6–7.3	Moderate	High	Low.
95–100	90–100	85–90	65–75	15–35	6–14	0.6–2.0	0.17–0.19	7.4–7.8	Low	High	Low.

support load and resist settlement under load, and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks. Wetness is a major factor to be considered for buildings with basements. Corrosion potential of the soil and slope are important factors in construction of small commercial buildings.

Local roads and streets, as rated in table 8, have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface commonly of asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand. Most cuts and fills are less than 5 feet deep.

Soil properties that most affect design and construction of roads and streets are load supporting capacity and stability of the subgrade and the workability and quantity of cut and fill material available. The AASHTO and Unified classifications of the soil material and the shrink-swell potential indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, stoniness, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade. Additional information can be obtained from the

TABLE 8.—*Sanitary facilities*

[An asterisk in the first column indicates that at least one mapping unit is made up of two or more kinds of soil. The soils in such first column of this table carefully. Absence of data indicates that the soil is too variable to

Soil series and map symbols	Degree and kind of limitation for—			
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basements
Adrian: Ad	Severe: wetness; floods.	Severe: wetness; floods.	Severe: wetness; floods; cutbanks cave.	Severe: floods; wetness; excess humus.
Blount:				
BdA	Severe: wetness; percs slowly.	Slight	Severe: wetness	Severe: wetness; frost action.
BdB	Severe: wetness; percs slowly.	Moderate: slope	Severe: wetness	Severe: wetness; frost action.
Borrow land: Bh. Too variable to rate.				
Boyer:				
BnB	Slight[1]	Severe: seepage	Severe: cutbanks cave.	Slight
BnC	Moderate: slope.[1]	Severe: seepage; slope.	Severe: cutbanks cave.	Slight
BoB	Slight[1]	Severe: seepage	Severe: cutbanks cave.	Slight
BoC	Moderate: slope.[1]	Severe: seepage; slope.	Severe: cutbanks cave.	Moderate: slope
BoD, BoE	Severe: slope[1]	Severe: seepage; slope.	Severe: cutbanks cave.	Severe: slope
*Capac: CaA, CbB For Marlette part of CbB, see Marlette series.	Severe: wetness; percs slowly.	Severe: wetness	Severe: wetness	Severe: frost action; wetness.
Ceresco: Ce	Severe: wetness; floods.	Severe: seepage; floods; wetness.	Severe: wetness; floods.	Severe: wetness; floods; frost action.
Cohoctah: Ch	Severe: wetness; floods.	Severe: seepage; floods.	Severe: wetness; floods.	Severe: wetness; floods; frost action.
Colwood: Co	Severe: wetness	Severe: wetness	Severe: wetness; cutbanks cave.	Severe: wetness; frost action; low strength.
Corunna: Cr	Severe: wetness; percs slowly.	Severe: wetness	Severe: wetness	Severe: wetness; frost action.
Edwards: Ed	Severe: wetness; floods.	Severe: wetness; seepage; floods.	Severe: wetness; floods; cutbanks cave.	Severe: excess humus; wetness; floods; frost action; low strength.
Gilford: Gf	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness; frost action.
Granby: Gr	Severe: wetness	Severe: wetness; seepage.	Severe: wetness; cutbanks cave.	Severe: wetness
Houghton: Ho	Severe: wetness; floods.	Severe: wetness; seepage; excess humus; floods.	Severe: wetness; floods; excess humus; cutbanks cave.	Severe: wetness; excess humus; frost action; low strength; floods.

and building sites

mapping units may have different properties and limitations, and for this reason it is necessary to follow the instructions in the be rated or that no estimate was made. Some terms in this table are explained in the glossary]

Degree and kind of limitation for—Continued					
Dwellings with basements	Small commercial buildings	Local roads and streets	Sanitary landfill (trench)	Sanitary landfill (area)	Daily cover for landfill
Severe: wetness; floods.	Severe: wetness; floods; frost action.	Severe: wetness; floods; low strength.	Severe: wetness; floods; seepage.	Severe: wetness; floods; seepage.	Poor: excess humus; hard to pack.
Severe: wetness; frost action.	Severe: wetness; frost action.	Severe: low strength; frost action.	Severe: wetness	Severe: wetness	Fair: too clayey.
Severe: wetness; frost action.	Severe: wetness; frost action.	Severe: low strength; frost action.	Severe: wetness	Severe: wetness	Fair: too clayey.
Slight	Slight	Slight	Severe: seepage	Severe: seepage	Fair: thin layer.
Slight	Severe: slope	Moderate: slope	Severe: seepage	Severe: seepage	Fair: thin layer.
Slight	Slight	Slight	Severe: seepage	Severe: seepage	Fair: too sandy; thin layer.
Moderate: slope	Severe: slope	Moderate: slope	Severe: seepage	Severe: seepage	Fair: too sandy; thin layer.
Severe: slope	Severe: slope	Severe: slope	Severe: seepage	Severe: seepage; slope.	Poor: slope.
Severe: wetness	Severe: frost action; wetness.	Severe: frost action.	Severe: wetness	Severe: wetness	Good.
Severe: floods; wetness.	Severe: floods; wetness; frost action.	Severe: frost action.	Severe: wetness; floods; seepage.	Severe: wetness; floods; seepage.	Good.
Severe: wetness; floods.	Severe: floods; wetness; frost action.	Severe: floods; frost action; wetness.	Severe: wetness; floods; seepage.	Severe: seepage; floods; wetness.	Poor: wetness.
Severe: wetness; low strength.	Severe: wetness; frost action; low strength.	Severe: wetness; frost action; low strength.	Severe: wetness	Severe: wetness	Poor: wetness.
Severe: wetness	Severe: wetness; frost action.	Severe: wetness; frost action.	Severe: wetness	Severe: wetness	Poor: wetness.
Severe: excess humus; floods; wetness; low strength.	Severe: excess humus; floods; wetness; frost action; low strength.	Severe: floods; wetness; frost action; low strength; excess humus.	Severe: wetness; floods; seepage.	Severe: wetness; floods; seepage.	Poor: wetness; seepage; excess humus.
Severe: wetness	Severe: wetness; frost action.	Severe: wetness; seepage.	Severe: wetness; seepage.	Severe: wetness; seepage.	Poor: wetness.
Severe: wetness; floods.	Severe: wetness; floods.	Severe: wetness	Severe: wetness; seepage.	Severe: wetness; seepage.	Poor: wetness; too sandy.
Severe: wetness; floods; excess humus; low strength.	Severe: wetness; floods; low strength.	Severe: wetness; excess humus; low strength.	Severe: wetness; floods.	Severe: wetness; floods; seepage.	Poor: excess humus; wetness; hard to pack.

TABLE 8.—*Sanitary facilities*

Soil series and map symbols	Degree and kind of limitation for—			
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basements
Kibbie: KbA	Severe: wetness	Severe: wetness	Severe: wetness; cutbanks cave.	Severe: wetness; frost action; low strength.
Lapeer: LaB	Slight	Severe: seepage	Slight	Moderate: frost action.
Marlette:				
MaB	Moderate: percs slowly.	Moderate: seepage; slope.	Slight	Moderate: frost action.
MaC, MbC3	Moderate: slope; percs slowly.	Severe: slope	Moderate: slope	Moderate: slope
MaD, MaE, MbD3	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Matherton: MdA	Severe: wetness.[1]	Severe: wetness; seepage.	Severe: wetness; cutbanks cave.	Severe: wetness; frost action.
*Metamora: MeA For Capac part, see Capac series.	Severe: wetness; percs slowly.	Severe: wetness	Severe: wetness	Severe: wetness; frost action.
Metea: MhB	Moderate: percs slowly.	Moderate: seepage.	Slight	Moderate: frost action.
Morley:				
MoB	Severe: percs slowly.	Moderate: slope	Slight	Moderate: shrink-swell potential; frost action.
MoC	Severe: percs slowly.	Severe: slope	Moderate: slope	Moderate: shrink-swell potential; frost action.
Oakville: OaB	Slight[1]	Severe: seepage	Severe: cutbanks cave.	Slight
Oshtemo: OsB	Slight[1]	Severe: seepage	Severe: cutbanks cave.	Slight
*Owosso:				
OtA, OwB For Marlette part of OwB, see Marlette series.	Severe: percs slowly.	Severe: seepage	Slight	Moderate: frost action.
OwC For Marlette part of OwC, see Marlette series.	Severe: percs slowly.	Severe: seepage	Moderate: slope	Moderate: frost action; slope.
Palms: Pa	Severe: wetness; floods.	Severe: wetness; floods; excess humus.	Severe: wetness; floods; excess humus.	Severe: wetness; floods; frost action; excess humus.
Parkhill: Pr	Severe: wetness; percs slowly; floods.	Severe: wetness	Severe: wetness; floods.	Severe: frost action; wetness; floods.
Sebewa: Sb	Severe: wetness;[1] floods.	Severe: wetness; seepage.	Severe: wetness; cutbanks cave; floods.	Severe: wetness; frost action; floods.
Selfridge: SeA	Severe: wetness; percs slowly.	Severe: wetness	Severe: wetness; cutbanks cave.	Severe: wetness; frost action.
Shoals: Sh	Severe: wetness; floods; percs slowly.	Severe: wetness; floods.	Severe: wetness; floods.	Severe: wetness; floods; frost action.

and building sites—Continued

Degree and kind of limitation for—Continued					
Dwellings with basements	Small commercial buildings	Local roads and streets	Sanitary landfill (trench)	Sanitary landfill (area)	Daily cover for landfill
Severe: wetness; low strength.	Severe: wetness; low strength; frost action.	Severe: frost action; low strength.	Severe: wetness	Severe: wetness	Good.
Slight	Moderate: frost action.	Moderate: frost action.	Severe: seepage	Slight	Good.
Slight	Moderate: frost action.	Moderate: frost action.	Slight	Slight	Fair: too clayey.
Moderate: slope	Severe: slope	Moderate: frost action; slope.	Slight	Moderate: slope	Fair: too clayey; slope.
Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope	Poor: slope.
Severe: wetness	Severe: wetness; frost action.	Severe: frost action.	Severe: wetness; seepage.	Severe: wetness; seepage.	Fair: thin layer.
Severe: wetness	Severe: wetness; frost action.	Severe: frost action.	Severe: wetness	Severe: wetness	Good.
Severe: wetness	Moderate: frost action.	Moderate: frost action.	Slight	Slight	Fair: too sandy.
Moderate: shrink-swell potential.	Moderate: shrink-swell potential.	Severe: shrink-swell potential.	Slight	Slight	Fair: too clayey.
Moderate: shrink-swell potential.	Moderate: shrink-swell potential.	Severe: shrink-swell potential.	Slight	Moderate: slope	Fair: too clayey.
Slight	Slight	Slight	Severe: seepage	Severe: seepage	Poor: too sandy; seepage.
Slight	Slight	Slight	Severe: seepage	Severe: seepage	Poor: seepage.
Slight	Moderate: frost action.	Moderate: frost action.	Slight	Slight	Good.
Slight	Severe: slope	Moderate: frost action; slope.	Slight	Moderate: slope	Fair: slope.
Severe: wetness; floods.	Severe: floods; wetness.	Severe: wetness; excess humus; low strength.	Severe: wetness; floods; seepage.	Severe: wetness; floods; seepage.	Poor: excess humus.
Severe: wetness; floods.	Severe: frost action; wetness; floods.	Severe: frost action; wetness; floods.	Severe: wetness; floods.	Severe: wetness; floods.	Poor: wetness.
Severe: wetness; floods.	Severe: wetness; frost action; floods.	Severe: wetness; frost action.	Severe: wetness; seepage; floods.	Severe: wetness; seepage; floods.	Poor: wetness.
Severe: wetness	Severe: wetness; frost action.	Severe: frost action.	Severe: wetness	Moderate: wetness.	Poor: too sandy.
Severe: wetness; floods.	Severe: floods; frost action.	Severe: floods; frost action.	Severe: floods	Severe: floods; wetness.	Good.

TABLE 8.—*Sanitary facilities*

Soil series and map symbols	Degree and kind of limitation for—			
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basements
Sims: Sm	Severe: wetness; percs slowly; floods.	Severe: wetness; floods.	Severe: wetness	Severe: wetness; frost action; floods.
Sisson: SnB	Slight	Moderate: slope	Moderate: cutbanks cave.	Moderate: frost action; low strength.
Sloan: So	Severe: wetness; floods; percs slowly.	Severe: floods; wetness.	Severe: wetness; floods.	Severe: wetness; floods; frost action.
Spinks: SpB	Slight[1]	Severe: seepage	Severe: cutbanks cave.	Slight
SpC	Moderate: slope.[1]	Severe: seepage; slope.	Severe: cutbanks cave.	Moderate: slope
Spinks variant: StB	Slight[1]	Severe: seepage; small stones.	Severe: cutbanks cave.	Severe: small stones.
Thetford: ThA	Severe: wetness.[1]	Severe: seepage; wetness.	Severe: wetness; cutbanks cave.	Severe: wetness
Wallkill: Wa	Severe: wetness; floods; excess humus in substratum.	Severe: wetness; floods; seepage.	Severe: wetness; cutbanks cave.	Severe: wetness
Wasepi: WbA	Severe: wetness.[1]	Severe: seepage; wetness.	Severe: wetness; cutbanks cave.	Severe: frost action; wetness.
Washtenaw: Wd	Severe: wetness; floods; percs slowly.	Severe: wetness; floods.	Severe: wetness; floods.	Severe: wetness; frost action; floods.

[1] Possibility of contamination of shallow water supply.

Michigan Department of Highways and Transportation which has rated the major soil series in the State for their suitability for highway construction. This information is in the "Field Manual of Soil Engineering" (*3*).

Town and country planning

Town and country planning and the accompanying extension of public utilities and the establishment of business and recreational facilities create a need for soil information. This information differs somewhat from the information needed for farming. Land appraisers, realtors, city planners, builders, and others need facts that will help them determine what sites are suited to homes and other buildings and what sites are best suited to other uses. This section provides information for those who want to improve their property and protect it against the erosion hazards of built-up communities.

Residences.—Soil properties have an important effect on the suitability of a site for residential development, whether it is for a subdivision or an individual home. Soil drainage, permeability, stability of the soil material, frequency of flooding, slope, and erosion hazard are important considerations.

Homes built on poorly drained and very poorly drained soils, such as Corunna, Gilford, Parkhill, and Granby soils, are likely to have wet basements unless artificial drainage is provided. A high water table, even if it is only seasonal, keeps septic tank filter fields from functioning properly. Information on the occurrence of a high water table is given in table 7, and interpretations for drainage are given in table 9.

Permeability is another property that affects the functioning of septic tank filter fields. Sandy soils that have rapid permeability, such as Oakville and Spinks soils, may allow unfiltered effluent to enter and contaminate a shallow water supply. Information on permeability is given in table 7. Limitations for septic tank filter fields in table 8 furnishes information about the limitations of all the soils in disposal of sewage.

Some soils provide good foundations for homes, but

and building sites—Continued

Degree and kind of limitation for—Continued					
Dwellings with basements	Small commercial buildings	Local roads and streets	Sanitary landfill (trench)	Sanitary landfill (area)	Daily cover for landfill
Severe: wetness; floods.	Severe: wetness; frost action; floods.	Severe: wetness; frost action; floods.	Severe: wetness; floods.	Severe: wetness; floods.	Poor: wetness.
Moderate: low strength.	Moderate: frost action; low strength.	Moderate: frost action; low strength.	Slight	Slight	Good.
Severe: floods; wetness.	Severe: floods; wetness; frost action.	Severe: wetness; floods; frost action.	Severe: floods; wetness.	Severe: wetness; floods.	Poor: wetness.
Slight	Slight	Slight	Severe: seepage; too sandy.	Severe: seepage	Poor: seepage; too sandy.
Moderate: slope	Severe: slope	Moderate: slope	Severe: seepage; too sandy.	Severe: seepage	Poor: seepage; too sandy.
Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: seepage	Severe: seepage	Poor: small stones; too sandy.
Severe: wetness	Severe: wetness	Moderate: wetness; frost action.	Severe: seepage; wetness.	Severe: seepage; wetness.	Poor: small stones; too sandy.
Severe: wetness	Severe: floods; wetness.	Severe: wetness; floods; excess humus.	Severe: wetness; seepage; floods.	Severe: wetness; floods; seepage.	Poor: wetness.
Severe: wetness	Severe: wetness; frost action.	Severe: frost action.	Severe: wetness; seepage.	Severe: wetness; seepage.	Fair: thin layer.
Severe: wetness; floods.	Severe: wetness; floods; frost action.	Severe: wetness; frost action; floods.	Severe: wetness; floods.	Severe: wetness; floods.	Poor: wetness.

others do not. Estimates for the shrink-swell potential in table 7 and interpretations for foundations for low buildings in table 8 identify soils with the fewest limitations for foundations. Such soils as Oshtemo, Boyer, and Spinks soils provide good foundations. Houghton and Adrian soils have severe limitations for foundations because of the presence of unstable organic material.

Soils on bottom land, such as some areas of Sloan and Cohoctah soils, are subject to flooding and consequently have severe hazards for building sites.

Erosion and the accumulation of sediment are serious hazards in construction in areas of sloping soils. As a result of paving and compaction of soil material during construction, runoff from built-up areas is 2 to 10 times as much as from the same area in farms or forest. The runoff concentrates in streets and gutters instead of flowing into natural waterways, and the result is flooding and deposition of sediments in lower areas. The steeper the slope, the more severe the hazard. Sloping to steep areas of Boyer and Marlette soils are particularly susceptible to rapid runoff and erosion. Measures that can be taken to control erosion in residential tracts include—

1. Constructing driveways, walks, and fences on the contour or, if that is not possible, straight across the slope.
2. Grading to make the surface level or gently sloping. The topsoil can be removed prior to grading and used later for surfacing.
3. Building diversions that will intercept runoff and keep it from flowing over erodible areas.
4. Constructing waterways or improving existing waterways to prevent gullying.
5. Draining seepage areas and waterlogged areas by using tile or other facilities.

Table 9 provides information on features that affect use of the soil for diversions, grassed waterways, and artificial drainage.

Streets, driveways, sidewalks, and patios.—Of special interest to homeowners and developers is the suitabil-

TABLE 9.—*Source of construction*

[An asterisk in the first column indicates that at least one mapping unit is made up of two or more kinds of soil. The soils in such first column of this table carefully. Absence of data indicates that the soil is too variable to

Soil series and map symbols	Suitability as source of—			
	Roadfill	Sand	Gravel	Topsoil
Adrian: Ad	Poor: excess humus; wetness.	Poor: excess fines.	Poor: excess fines.	Poor: wetness
Blount:				
BdA	Poor: frost action; low strength.	Unsuited	Unsuited	Fair: thin layer
BdB	Poor: frost action; low strength.	Unsuited	Unsuited	Fair: thin layer
Borrow land: Bh. Too variable to rate.				
Boyer:				
BnB	Good	Good	Good	Good
BnC	Good	Good	Good	Fair: slope
BoB	Good	Good	Good	Poor: too sandy
BoC	Good	Good	Good	Poor: too sandy
BoD, BoE	Fair: slope	Good	Good	Poor: too sandy; slope.
*Capac: CaA, CbB. For Marlette part of CbB, see Marlette series.	Poor: frost action.	Unsuited	Unsuited	Fair: thin layer
Ceresco: Ce	Poor: frost action.	Poor: excess fines.	Unsuited	Good
Cohoctah: Ch	Poor: wetness; frost action.	Unsuited	Unsuited	Poor: wetness
Colwood: Co	Poor: wetness; frost action; low strength.	Unsuited	Unsuited	Poor: wetness
Corunna: Cr	Poor: frost action; wetness.	Unsuited	Unsuited	Poor: wetness

material and water management

mapping units may have different properties and limitations, and for this reason it is necessary to follow the instructions in the be rated or that no estimate was made. Some terms in this table are explained in the glossary]

Soil features affecting—						
Pond reservoir area	Embankments, dikes, and levees	Excavated ponds aquifer fed	Drainage of cropland and pasture	Irrigation	Terraces and diversions	Grassed waterways
Seepage	Excess humus; seepage; hard to pack.	Favorable	Wetness; cutbanks cave; floods.	Seepage; wetness; soil blowing.	Not needed	Not needed.
Favorable	Favorable	Deep to water	Percs slowly	Slow intake; wetness.	Not needed	Not needed.
Favorable	Favorable	Deep to water	Percs slowly	Slow intake; wetness.	Not needed	Not needed.
Seepage	Seepage	No water	Not needed	Seepage; fast intake; low available water capacity.	Complex slopes	Droughty.
Slope; seepage	Seepage	No water; slope.	Not needed	Seepage; fast intake; low available water capacity.	Complex slopes	Droughty.
Seepage	Seepage	No water	Not needed	Seepage; fast intake; low available water capacity.	Complex slopes	Droughty.
Slope; seepage	Seepage	No water; slope.	Not needed	Seepage; fast intake; low available water capacity.	Complex slopes	Droughty.
Slope; seepage	Seepage; slope	No water; slope.	Not needed	Seepage; fast intake; low available water capacity.	Slope	Slope.
Favorable	Favorable	Slow refill	Wetness; percs slowly.	Wetness; percs slowly.	Not needed	Favorable.
Favorable	Unstable fill; piping; erodes easily.	Favorable	Floods; wetness.	Fast intake; floods; wetness.	Not needed	Not needed.
Seepage	Piping	Favorable	Wetness; floods.	Rapid intake; floods; wetness.	Not needed	Not needed.
Seepage	Low strength; piping.	Favorable	Wetness; cutbanks cave.	Wetness	Not needed	Not needed.
Favorable	Favorable	Favorable	Wetness; poor outlets.	Wetness; fast intake.	Not needed	Not needed.

TABLE 9.—*Source of construction*

Soil series and map symbols	Suitability as source of—			
	Roadfill	Sand	Gravel	Topsoil
Edwards: Ed	Poor: excess humus; frost action; low strength; wetness.	Unsuited	Unsuited	Poor: excess humus; wetness.
Gilford: Gf	Poor: wetness; frost action.	Good	Good	Poor: wetness
Granby: Gr	Poor: wetness	Good	Unsuited	Poor: too sandy; wetness.
Houghton: Ho	Poor: excess humus; wetness; low strength.	Unsuited	Unsuited	Poor: excess humus; wetness.
Kibbie: KbA	Poor: frost action; low strength.	Unsuited	Unsuited	Good
Lapeer: LaB	Fair: frost action.	Unsuited	Unsuited	Good
Marlette:				
MaB	Fair: frost action.	Unsuited	Unsuited	Fair: thin layer
MaC, MbC3	Fair: frost action.	Unsuited	Unsuited	Fair: thin layer
MaD, MaE, MbD3	Fair: frost action; slope.	Unsuited	Unsuited	Poor: slope
Matherton: MdA	Poor: frost action.	Good	Good	Fair: thin layer
*Metamora: MeA For Capac part, see Capac series.	Poor: frost action.	Unsuited	Unsuited	Good
Metea: MhB	Fair: frost action.	Unsuited	Unsuited	Poor: too sandy
Morley:				
MoB	Poor: shrink-swell potential.	Unsuited	Unsuited	Fair: thin layer
MoC	Poor: shrink-swell potential.	Unsuited	Unsuited	Fair: thin layer
Oakville: OaB	Good	Good	Unsuited	Poor: too sandy
Oshtemo: OsB	Good	Good	Good	Good
*Owosso:				
OtA, OwB For Marlette part of OwB, see Marlette series.	Fair: frost action; shrink-swell potential.	Unsuited	Unsuited	Good
OwC For Marlette part of OwC, see Marlette series.	Fair: frost action; shrink-swell potential.	Unsuited	Unsuited	Fair: slope
Palms: Pa	Poor: excess humus; frost action; wetness.	Unsuited	Unsuited	Poor: wetness

material and water management—Continued

Soil features affecting—						
Pond reservoir area	Embankments, dikes, and levees	Excavated ponds aquifer fed	Drainage of cropland and pasture	Irrigation	Terraces and diversions	Grassed waterways
Seepage	Excess humus; compressible; low strength.	Favorable	Floods; cutbanks cave.	Seepage; wetness; fast intake; soil blowing.	Not needed	Not needed.
Seepage	Seepage; piping.	Favorable	Wetness; cutbanks cave.	Fast intake; wetness.	Not needed	Not needed.
Seepage	Unstable fill; seepage; piping.	Favorable	Wetness; cutbanks cave.	Fast intake; wetness.	Not needed	Not needed.
Seepage; cutbanks cave.	Low strength; seepage; compressible; unstable fill.	Favorable	Wetness; floods; cutbanks cave.	Fast intake; soil blowing.	Not needed	Not needed.
Seepage	Unstable fill; compressible.	Deep to water	Wetness; cutbanks cave.	Wetness	Not needed	Favorable.
Seepage	Piping	Deep to water; slow refill.	Not needed	Fast intake; complex slopes.	Complex slopes	Erodes easily.
Favorable	Low strength	No water	Not needed	Complex slopes	Complex slopes; erodes easily.	Erodes easily.
Slope	Low strength	No water	Not needed	Complex slopes	Complex slopes; erodes easily.	Erodes easily.
Slope	Low strength	No water; no slope.	Not needed	Slope	Slope; erodes easily.	Slope; erodes easily.
Seepage	Favorable in upper 20 to 40 inches; seepage in underlying material.	Favorable	Wetness; cutbanks cave.	Wetness	Not needed	Favorable.
Favorable	Piping	Favorable	Percs slowly; wetness.	Wetness	Not needed	Favorable.
Seepage	Favorable	No water	Not needed	Fast intake	Too sandy; complex slopes.	Droughty.
Favorable	Favorable	Slow refill	Not needed	Slow intake; slope.	Slope	Erodes easily.
Slope	Favorable	Slow refill	Not needed	Slow intake; slope.	Slope	Erodes easily.
Seepage	Seepage; erodes easily.	No water	Not needed	Fast intake; soil blowing.	Too sandy	Droughty.
Seepage	Seepage	No water	Not needed	Fast intake	Complex slopes	Favorable.
Seepage	Favorable	No water	Not needed	Fast intake; erodes easily.	Complex slopes	Erodes easily.
Seepage; slope	Favorable	No water	Not needed	Fast intake; erodes easily; complex slope.	Complex slopes	Erodes easily.
Seepage	Compressible; low strength; hard to pack.	Favorable	Wetness; cutbanks cave.	Fast intake; wetness.	Not needed	Not needed.

TABLE 9.—*Source of construction*

Soil series and map symbols	Suitability as source of—			
	Roadfill	Sand	Gravel	Topsoil
Parkhill: Pr	Poor: frost action; wetness.	Unsuited	Unsuited	Poor: wetness
Sebewa: Sb	Poor: wetness; frost action.	Good	Good	Poor: wetness
Selfridge: SeA	Poor: frost action.	Poor: excess fines.	Unsuited	Poor: too sandy
Shoals: Sh	Poor: frost action.	Unsuited	Unsuited	Good
Sims: Sm	Poor: wetness; frost action.	Unsuited	Unsuited	Poor: wetness
Sisson: SnB	Fair: frost action; low strength.	Unsuited	Unsuited	Good
Sloan: So	Poor: wetness; frost action.	Unsuited	Unsuited	Poor: wetness
Spinks: SpB	Good	Good	Unsuited	Poor: too sandy; thin layer.
SpC	Good	Good	Unsuited	Poor: too sandy; thin layer.
Spinks variant: StB	Fair: small stones.	Good	Poor	Poor: too sandy; small stones; thin layer.
Thetford: ThA	Fair: wetness	Fair: excess fines.	Unsuited	Poor: too sandy
Wallkill: Wa	Poor: frost action; unstable; excess humus in substratum; low strength.	Unsuited	Unsuited	Poor: wetness
Wasepi: WbA	Poor: frost action; wetness.	Good	Good	Fair: thin layer
Washtenaw: Wd	Poor: frost action; wetness.	Unsuited	Unsuited	Poor: wetness

ity of the soils for streets, driveways, sidewalks, and patios. Soils that have a high silt content, such as Kibbie and Colwood soils, are subject to the hazard of frost heave. Concrete cracks readily if placed on these soils without first covering the surface of the soil with sand and gravel. Soils that have a high content of clay, such as Morley soils, also cause pavement and sidewalks to crack and shift excessively. The very poorly drained Houghton and Edwards soils settle rapidly, especially after drainage. This settling causes cracking of pavement and an uneven surface. The estimates of shrink-swell potential in table 7 and interpretations for roadfill and local roads and streets in table 9 provide useful information that should be considered in constructing streets, driveways, sidewalks, and patios.

Underground utility lines.—Water mains, gas pipelines, communication lines, and sewer lines that are buried in the soil may corrode and break unless they are protected against certain electrobiochemical reactions. The reactions result from the inherent properties of the soil, and they differ according to the kind of soil. All metals corrode to some degree when buried in the soil, and some metals corrode more rapidly in some

material and water management—Continued

Soil features affecting—						
Pond reservoir area	Embankments, dikes, and levees	Excavated ponds aquifer fed	Drainage of cropland and pasture	Irrigation	Terraces and diversions	Grassed waterways
Favorable	Favorable	Favorable	Wetness; percs slowly.	Slow intake; wetness.	Not needed	Not needed.
Seepage	Piping; seepage.	Favorable	Wetness; cutbanks cave.	Wetness	Not needed	Not needed.
Seepage	Piping	Slow refill	Wetness; cutbanks cave; percs slowly.	Fast intake	Not needed	Not needed.
Favorable	Piping; low strength.	Favorable	Wetness; floods.	Floods	Not needed	Not needed.
Favorable	Shrink-swell potential.	Favorable	Wetness; percs slowly.	Percs slowly	Not needed	Not needed.
Seepage	Low strength; piping.	Deep to water	Not needed	Erodes easily	Complex slopes	Erodes easily.
Favorable	Piping	Favorable	Wetness; percs slowly; floods.	Floods	Not needed	Not needed.
Seepage	Seepage; piping.	Deep to water	Not needed	Soil blowing; fast intake.	Too sandy; complex slopes.	Droughty.
Seepage	Seepage; piping.	Deep to water	Not needed	Fast intake; slope; soil blowing.	Too sandy; complex slopes.	Droughty.
Seepage	Seepage; piping.	Deep to water	Not needed	Fast intake; soil blowing.	Too sandy; complex slopes.	Droughty.
Seepage	Seepage; piping.	Favorable	Wetness; cutbanks cave.	Seepage; wetness.	Not needed	Not needed.
Seepage	Low strength; excess humus in substratum.	Favorable	Wetness; floods.	Wetness	Not needed	Not needed.
Seepage	Seepage; piping.	Favorable	Wetness; cutbanks cave.	Fast intake; wetness.	Not needed	Droughty.
Favorable	Low strength	Favorable	Floods; percs slowly.	Wetness	Not needed	Not needed.

soils than in others. The corrosion potential depends on physical, chemical, electrical, and biological characteristics of the soil, for example, oxygen concentration, concentration of anaerobic bacteria, and moisture content. Design and construction are also influencing characteristics. The likelihood of corrosion is intensified by connecting dissimilar metals, by burying metal structures at varying depths, and by extending pipelines through different kinds of soils.

If cast iron pipe is used, stress caused by shrinking and swelling of the soils is an additional hazard. In soils that have a high shrink-swell potential, such as Edwards soils, cast iron pipe may break unless it is cushioned by sandy material. Estimates of shrink-swell potential for all the soils in Clinton County are given in table 7.

Gardening and landscaping.—Soil information is needed by homeowners and landscape architects in selecting flowers, shrubs, and trees for landscaping.

The ideal soils for yard and garden plants have a deep root zone, a loamy texture, a balanced supply of plant nutrients, an adequate organic-matter content, an adequate available water capacity, good drainage, and structure that allows free movement of water. Sis-

son soils closely approach this ideal. On such droughty soils as Oakville and Spinks soils, lawns and shrubs dry up quickly during dry periods unless they are watered frequently. Poorly drained and very poorly drained soils, such as Parkhill and Colwood soils, are difficult to work if wet, or if the surface layer dries out hard and cloddy. If the soils are disturbed during construction, the seeding of lawns is difficult.

The information under the heading "Trees and Shrubs for Landscaping and Windbreaks" can be helpful in landscaping.

Public health.—Soil information is needed in planning sewage disposal, trash disposal, and the maintenance of a safe and adequate water supply.

Sewage lagoons, septic tank systems, and sewerlines should be located and constructed so that seepage or drainage does not pollute the water supply. One cause of pollution is leakage from sewage lagoons built of unsuitable soil material. The sandy Oakville and Spinks soils have rapid and very rapid permeability and may allow pollution. Wells, streams, and lakes can become contaminated by runoff from clogged filter fields, and the rapid percolation of septic tank effluent can result in pollution of a shallow underground water supply. Table 9 provides information on embankments and septic tank filter fields for each soil in the county.

In selecting sites for sanitary landfill, it is important to consider the topography, drainage, and such soil characteristics as texture, permeability, reaction, and the nature of the underlying material. Table 7 lists estimates of the pertinent soil properties. The soil map can be used in locating areas of suitable soils. Table 8 rates the soils for landfill use.

The stability of the soils is of major importance in the location of sewerlines. If the gradeline is interrupted, the sewer system breaks down and a public health hazard results. Table 7 provides information on shrink-swell potential, or soil stability.

Mosquitoes, fleas, and other disease-carrying insects breed in stagnant water. By using the soil map and the soil descriptions it is possible to identify areas subject to flooding and ponding because of nearly level relief or poor internal drainage. Once these potential trouble spots are located, the health hazard can be controlled by spraying to eliminate insects and by installing drainage systems to remove the standing water.

Recreation.—Natural drainage, texture, slope, flood hazard, stones, and cobblestones are soil properties that affect the suitability of a site for recreational uses.

Poorly drained and very poorly drained soils that have a high water table, such as Corunna, Gilford, Granby, and Parkhill soils, are severely limited for use as campsites, picnic areas, and intensive play areas. Houghton and Palms soils are especially severely limited by very poor drainage and by unstable organic material. All of these soils, however, are suitable sites for pit ponds because of a high water table.

Level to gently sloping, well drained, loamy and sandy soils, such as Lapeer, Oshtemo, and Spinks soils, are slightly to moderately limited for campsites, picnic areas, intensive play areas, and building sites. These soils dry out quickly and therefore are firm for foot and vehicular traffic shortly after rain. Moderately steep to steep soils, such as Marlette, Owosso, and Boyers soils, are severely limited for use as campsites and picnic areas.

Table 6 lists soil information and interpretations important in planning recreational facilities.

Formation and Classification of Soils

This part of the survey tells how the factors of soil formation have affected the formation of soils in Clinton County. It also explains the system of soil classification and classifies each soil series according to that system.

Terms common in the current classification system that are used in this section are defined in the Glossary at the back of this survey or in the reference "Soil Taxonomy, A Basic System of Soil Classification for Making and Interpreting Soil Surveys (*7*).

Factors of Soil Formation

Soil is developed by soil-forming processes acting on materials deposited or accumulated by geologic actions. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material, the climate under which the soil material has accumulated and existed since accumulation, the plant and animal life on and in the soil, the relief, or lay of the land, and the length of time the forces of soil formation have acted on the parent material.

Climate, plants, and animal life are active factors of soil formation. They act on the parent material and slowly change it to a natural body of soil that has genetically related layers, or horizons. The effects of climate and of plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil with genetic horizons. It may be much or little time, but some amount of time is always required for differentiation of soil horizons. Usually, a long period of time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

Parent material is the unconsolidated mass from which a soil is formed. The parent material of the soils of Clinton County was deposited by glaciers or by melt water from the glaciers that covered the county from about 10,000 to 12,000 years ago. Some of this material was reworked and redeposited by subsequent actions of water and wind. Parent material determines the limits of the chemical and mineralogical composition of the soil. Although of common glacial origin, parent material varies greatly, sometimes within small areas, depending on how it was deposited. The dominant parent material in Clinton County was deposited as glacial till, glacial outwash, lacustrine sediment, alluvium, and organic material.

Glacial till is material laid down directly by glaciers with a minimum amount of water action. It is a mix-

ture of particles of different sizes. The small pebbles in glacial till have sharp corners, indicating that they have not been worn by water washing. The glacial till in Clinton County is calcareous and is friable or firm. It is sandy loam, loam, silty clay loam, and clay loam. Marlette soils are examples of soils formed in glacial till. They are loamy and have well developed structure.

Glacial outwash is deposited by running water from melting glaciers. The size of the particles deposited depends on the speed of the stream. As the velocity of the stream decreases, the coarser particles are deposited. Finer particles, such as very fine sand, silt, and clay, can be carried by slowly moving water. Outwash deposits generally consist of layers of particles of similar size. Sandy loam, sand, gravel, and other coarse particles are dominant. Boyer soils, for example, formed in deposits of outwash material in Clinton County.

Lacustrine sediments are deposited from still, or ponded, glacial melt water. Because the coarser fragments drop out of moving water as outwash, only the finer particles, such as very fine sand, silt, and clay remain to settle out in still water. Lacustrine deposits are silty or clayey. Sisson, Kibbie, and Colwood soils are examples of soils that formed in loamy lacustrine sediments.

Alluvium is deposited by flood waters of present streams in recent time. This material varies in texture, depending on the speed of the water from which it was deposited.

Organic material is made up of deposits of plant remains. After the glaciers withdrew from the area, water was left standing in depressions in outwash, lake, and till plains. Grasses and sedges growing around the edges of these lakes died, and their remains fell to the bottom. Because of the wetness of the areas, the plant remains did not decompose. Later, white cedar and other water-tolerant trees grew on the areas. As these trees died, their residue became a part of the organic accumulation. The lakes were eventually filled with organic material and developed into areas of muck and peat. In some of these areas, the plant remains subsequently decomposed. In others, the material has changed little since it was deposited. Houghton soils, for example, formed in organic material.

Plant and animal life

Plants have been the principal organisms influencing the soils in Clinton County. Bacteria, fungi, earthworms, and the activities of man, however, have also been important. The chief contribution of plants and animal life is the addition of organic matter and nitrogen to the soil. The kind of organic material on and in the soil depends on the kinds of plants that grew on the soil. The remains of these plants accumulate on the surface, decay, and eventually become organic matter. Roots of the plants provide channels for downward movement of water through the soil and add organic matter as they decay. Bacteria in the soil breaks down the organic matter so that it can be used by growing plants.

The vegetation in Clinton County was primarily deciduous forests. Differences in natural soil drainage and minor changes in parent material have affected the composition of the forest species.

In general, such better drained upland soils as Morley and Marlette soils were covered with such hardwoods as maple, ash, oak, hickory, and some white pine. A few wet soils also had sphagnum and other mosses that contributed substantially to the accumulation of organic matter. Houghton and Adrian soils formed under wet conditions and herbaceous vegetation. They contain a considerable amount of organic matter. Thus, the soils of Clinton County that formed under dominantly forest vegetation generally have less total accumulated organic matter than soils that formed under grass vegetation.

Climate

Climate is important in the formation of soils. It determines the kind of plant and animal life on and in the soil and the amount of water available for weathering of minerals and for the transporting of soil materials. Through its influence on soil temperature, climate also determines the rate of chemical reaction in the soil. These influences are important but affect large areas rather than a relatively small area, such as a county.

The climate in Clinton County is cool and humid, presumably similar to the climate under which the soils formed. The soils of this county differ from those formed in a dry, warm climate or a hot, moist climate. Climate is uniform throughout the county. Its effect is modified locally by microrelief.

Relief

Relief, or topography, has a marked influence on the soils through its influence on natural drainage, erosion, plant cover, and soil temperature. In Clinton County slopes range from level to steep. Natural soil drainage ranges from well drained on ridgetops to very poorly drained in depressions.

Relief influences the formation of soils by affecting runoff and drainage; drainage in turn, through its effect on soil aeration, determines the color of the soil. Runoff is most rapid on the steepest slopes. In low areas water is temporarily ponded. Water and air move freely through well drained soils but move slowly through very poorly drained soils. In well aerated soils, the iron and aluminum compounds that give most soils their color are brightly colored and oxidized. Poorly aerated soils are dull gray and mottled. Marlette soils, for example, are well drained or moderately well drained and well aerated. Parkhill soils, which formed in similar parent material, are poorly aerated and poorly drained to very poorly drained.

Capac soils are somewhat poorly drained. They have a fluctuating high water table. During dry periods in summer, the water table drops, allowing air into the soil profile. During wet periods the water table rises, and the air is squeezed out of the soil profile. Thus, both oxidation and reduction processes are at work, and the subsoil has a mottling of colors.

Time

Time, usually a long period of time, is required for the development of distinct horizons. Differences in the length of time that the parent material has been in place are commonly reflected in the degree of development of the soil profile. Some soils develop rapidly, others slowly.

The soils in Clinton County range from young to

mature. The glacial deposits from which many of the soils formed have been exposed to soil-forming factors for a long enough period that distinct horizons have developed within the soil profile. Other soils forming in recent alluvial sediments have not been in place long enough and have weakly defined horizons.

Cohoctah and Sloan soils are examples of young soils that formed in alluvial material, whereas Morley and Marlette soils are examples of mature soils that formed in glacial till material.

Genesis and Morphology of Soils

The processes or soil-forming factors responsible for the development of the soil horizons from the unconsolidated parent material are referred to as soil genesis. The physical, chemical, and biological properties of the various soil horizons are termed soil morphology.

Several processes were involved in the formation of soil horizons in Clinton County. These processes include the accumulation of organic matter, the leaching of lime (calcium carbonates) and other bases, the reduction and transfer of iron, and the formation and translocation of silicate clay minerals. In most soils more than one of these processes have been active in the development of horizons.

Organic matter has accumulated at the surface to form an A1 horizon. The A1 horizon is mixed into a plow layer, or Ap horizon, when the soil is plowed. The soils of Clinton County have a surface horizon in which the organic matter content ranges from high to low. In Colwood soils the content is high. In Oakville soils it is low.

Leaching of carbonates and other bases has taken place in most of the soils. Soil scientists generally agree that leaching of bases in soils usually precedes the translocation of silicate clay minerals and the development of horizons. Many of the soils are moderately to strongly leached. For example, Morley soils are leached of carbonates to a depth of 44 inches, whereas Blount soils are leached to a depth of only 31 inches.

Reduction and transfer of iron, called gleying, is evident in the somewhat poorly drained, poorly drained, and very poorly drained soils. The gray color in the subsoil horizons indicates the reduction and loss of iron. Sims soils are an example of the gleying and reduction process. Some horizons contain mottles, indicating a segregation of iron. This process has taken place in Thetford and Capac soils.

In some soils the translocation of clay minerals has contributed to horizon development. The eluviated, or leached, A2 horizon above the illuviated, or accumulated, B horizons has a platy structure, is lower in clay content, and generally is lighter in color. The B horizon typically has an accumulation of clay or clay films in pores and on surfaces of peds. Such soils were probably leached of carbonates and soluble salts to a considerable extent before the translocation of silicate clay. Leaching of bases and translocation of silicate clays are among the more important processes in horizon differentiation. Marlette soils, for example, have translocated silicate clays accumulated in the B horizon in the form of clay films.

Classification of Soils

Soils are classified so that their significant characteristics can be more easily remembered. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us understand their behavior and their response to manipulation. First through classification, and then through the use of soil maps, we can apply our knowledge of soils to small specific areas or to large tracts of land.

The Comprehensive Classification System, the system currently used, was adopted by the National Cooperative Soil Survey in 1965 (*7*). This system is under continual study. Therefore, readers interested in new developments and revision of this soil classification system should consult the latest available literature.

In the current system of classification, soils are placed into six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped together. The six categories of the current system are briefly defined in the following paragraphs.

ORDER. Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings to soils. The two exceptions to this are the Entisols and the Histosols which may occur in many different climates.

As shown in table 10, five soil orders are represented in Clinton County. These are Alfisols, Entisols, Histosols, Inceptisols, and Mollisols.

Entisols are recent soils. They lack genetic horizons or have only the beginnings of such horizons. Oakville soils are an example of Entisols.

Inceptisols most often are on young but not recent land surfaces. The Parkhill and Sims soils in Clinton County are examples of the Inceptisols.

Alfisols have a clay-enriched B horizon that is high in base saturation. Morley and Marlette soils represent the Alfisols in Clinton County.

Mollisols have a thick, dark colored surface layer. Colwood soils are an example of Mollisols.

Histosols, including the soils commonly identified as mucks, peats, organic soils, or bogs, formed in organic material. Houghton soils are an example.

SUBORDER. Each order is divided into suborders, primarily on the basis of those characteristics that produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging, or soil differences resulting from climate or vegetation. Examples of the suborder category are Aquepts and Udalfs.

GREAT GROUPS. Each suborder is divided into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The hori-

TABLE 10.—*Classification of soil series*

Series	Family	Subgroup	Order
Adrian	Sandy or sandy-skeletal, mixed, euic, mesic	Terric Medisaprists	Histosols.
Blount [1]	Fine, illitic, mesic	Aeric Ochraqualfs	Alfisols.
Borrow land	Sandy and loamy	Udorthents	Entisols.
Boyer	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Capac	Fine-loamy, mixed, mesic	Aeric Ochraqualfs	Alfisols.
Ceresco	Coarse-loamy, mixed, mesic	Fluvaquentic Hapludolls	Mollisols.
Cohoctah	Coarse-loamy, mixed, mesic	Fluvaquentic Haplaquolls	Mollisols.
Colwood	Fine-loamy, mixed, mesic	Typic Haplaquolls	Mollisols.
Corunna	Coarse-loamy, mixed, mesic	Typic Haplaquolls	Mollisols.
Edwards	Marly, euic, mesic	Limnic Medisaprists	Histosols.
Gilford	Coarse-loamy, mixed, mesic	Typic Haplaquolls	Mollisols.
Granby	Sandy, mixed, mesic	Typic Haplaquolls	Mollisols.
Houghton	Euic, mesic	Typic Medisaprists	Histosols.
Kibbie	Fine-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Lapeer	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Marlette	Fine-loamy, mixed, mesic	Glossoboric Hapludalfs	Alfisols.
Matherton	Fine-loamy over sandy-skeletal, mixed, mesic	Udollic Ochraqualfs	Alfisols.
Metamora [2]	Fine-loamy, mixed, mesic	Udollic Ochraqualfs	Alfisols.
Metea [3]	Loamy, mixed, mesic	Arenic Hapludalfs	Alfisols.
Morley	Fine, illitic, mesic	Typic Hapludalfs	Alfisols.
Oakville	Mixed, mesic	Typic Udipsamments	Entisols.
Oshtemo	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Owosso	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Palms	Loamy, mixed, euic, mesic	Terric Medisaprists	Histosols.
Parkhill	Fine-loamy, mixed, nonacid, mesic	Mollic Haplaquepts	Inceptisols.
Sebewa	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Typic Argiaquolls	Mollisols.
Selfridge	Loamy, mixed, mesic	Aquic Arenic Hapludalfs	Alfisols.
Shoals	Fine-loamy, mixed, nonacid, mesic	Aeric Fluvaquents	Entisols.
Sims [4]	Fine, mixed, nonacid, frigid	Mollic Haplaquepts	Inceptisols.
Sisson	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Sloan	Fine-loamy, mixed, mesic	Fluvaquentic Haplaquolls	Mollisols.
Spinks	Sandy, mixed, mesic	Psammentic Hapludalfs	Alfisols.
Spinks variant	Sandy-skeletal, mixed, mesic	Psammentic Hapludalfs	Alfisols.
Thetford	Sandy, mixed, mesic	Psammaquentic Hapludalfs	Alfisols.
Wallkill	Fine-loamy, mixed, nonacid, mesic	Thapto-Histic Fluvaquents	Entisols.
Wasepi	Coarse-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Washtenaw	Fine-loamy, mixed, nonacid, mesic	Typic Haplaquents	Entisols.

[1] These soils are taxadjuncts to the series because the upper part of the B horizon is less acid than is defined as the range for the series.

[2] These soils are taxadjuncts to the series because they lack sufficient gray mottles to meet the definitions of Aqualfs.

[3] These soils are taxadjuncts to the series because they have thinner argillic horizons than is defined as the range for the series.

[4] These soils are taxadjuncts to the series because they have slightly warmer soil temperatures than is defined as the range for the series.

zons used to make separations are those in which clay, iron, or humus have accumulated or those that have pans that interfere with the growth of roots or movement of water. The features used are some properties of clays, soil temperature, and major differences in chemical composition, mainly in calcium, magnesium, sodium, and potassium.

SUBGROUPS. Each great group is divided into subgroups, one representing the central concept of the group and others called intergrades and extragrades. Intergrade subgroups have properties of the group and also one or more properties of another great group, suborder, or order. Extragrade subgroups have properties of the group and have characteristics that are not diagnostic of another great group, suborder, or order. Examples of subgroup names are Typic Hapludalfs for central concept, Mollic Haplaquepts for intergrades, and Aeric Haplaquepts for extragrades.

FAMILIES. Families are established within a subgroup primarily on the basis of properties important to the growth of plants or behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, depth, slope, consistence, and coatings. A family name consists of a series of adjectives which are the class names for texture, mineralogy, and so on. These are used as family differentiae. An example is the fine, illitic, mesic family.

SERIES. The series is a group of soils that have major horizons that, except for the texture of the surface layer, are similar in important characteristics and in arrangement of the profile. They are commonly given the name of a geographic location near the place where that series was first observed and mapped.

In table 10 each soil series in Clinton County is classified according to family, subgroup, and order.

Environmental Factors Affecting Soil Use

On the pages that follow are facts about the climate

TABLE 11.—*Temperature and precipitation data*

[All data based on records from St. Johns in the period 1940–69]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with—		Average total	One year in 10 will have—		Average number of days with 1 inch or more of snow cover	Average depth of snow on days with snow cover
			Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—		Less than—	More than—		
	°F	°F	°F	°F	In	In	In		In
January	30.2	14.4	45	−3	1.63	.55	2.95	19	4.5
February	33.4	15.6	46	−2	1.41	.39	2.71	18	6.2
March	42.4	23.2	62	6	1.97	.77	3.42	8	4.6
April	58.6	35.2	77	22	3.05	1.61	4.71	1	3.2
May	70.2	44.7	84	31	2.73	1.10	4.69	0	0
June	80.1	55.3	91	42	3.47	1.76	5.44	0	0
July	83.7	58.7	92	49	2.97	1.24	5.04	0	0
August	82.0	56.9	92	45	3.41	1.24	6.05	0	0
September	74.7	50.5	88	37	2.90	1.12	5.07	0	0
October	64.0	41.3	80	27	2.35	.60	4.59	0	0
November	47.2	30.6	63	16	2.25	1.12	3.55	3	2.9
December	35.0	20.3	52	4	1.91	.58	3.59	25	1.7
Year	58.5	37.2	[1] 94	[2] −9	30.05	23.82	36.60	74	3.9

[1] Average yearly maximum.

[2] Average yearly minimum.

of Clinton County and the physiography and surface geology. Also on these pages is information on farming and farm statistics from the 1969 Census of Agriculture.

Climate [8]

Because of the inland location in south-central Michigan, influence of the Great Lakes on the climate of Clinton County is minimized. The most noticeable influence is the increased cloudiness, which moderates the minimum temperature during cold air outbreaks late in fall and early in winter. The continental character of the climate is reflected by the larger daily, seasonal, and annual temperature changes experienced at St. Johns, for example, as compared with stations nearer the Great Lakes at a similar latitude. Because the day-to-day weather is controlled largely by the movement of pressure systems across the nation, prolonged periods of either hot, humid weather in summer or extreme cold during the winter are seldom experienced. Climatological data for the county is given in tables 11, 12, and 13.

The highest temperature of record was 102°F on August 6, 1947, and the lowest, −22° on February 10, 1899. The warmest monthly mean temperature was 76.6° in July, 1901, and the coldest was 12.6° in February, 1904. On the average, the temperature is 90° or higher 14 days per year. Eight times during the 1940–69 period, the temperature reached or exceeded 100°. During the same period, the temperature dropped to below zero in all years but 1941. The lake influence is reflected in the milder minimum temperatures. On an average, 86 percent of the minimum temperature from November through March is 32° or below. On 10 days per year, the temperature falls to below zero. The average heating- and cooling-degree days, base 65°, are 6,887 and 645 respectively. January, the coldest month, records an average of 1,314 heating-degree days. July, the warmest, has an average of 16 heating-degree days and 210 cooling-degree days.

The growing season averages 143 days. The average date of the last freezing temperature in spring is May 13, and the average date of the first freezing temperature in fall is October 3.

Precipitation is well distributed throughout the year. The crop season, May to October, receives an average of 17.83 inches, or 59 percent of the average annual total of 30.05 inches. June, which has an average of 3.47 inches, is the wettest month. The average in August is 3.41 inches. February with an average of 1.41 inches is the driest month. Summer precipitation is mainly in the form of afternoon showers and thundershowers. Annually, thunderstorms will occur on an average of 34 days. The highest monthly precipitation total on record, 8 inches, occurred in September 1950. About once in 2 years, as much as 1.2 inches of rain falls in 1 hour, as much as 1.4 inches in 2 hours, and as much as 2.3 inches in 24 hours. About once in 10 years as much as 3.0 inches falls in 24 hours, and once in 50 years, as much as 3.8 inches falls in 24 hours.

[8] FRED V. NURNBERGER, meteorologist for Michigan Department of Agriculture, Weather Service, helped prepare this section.

TABLE 12.—*Probabilities of last freezing temperatures in spring and first in fall*

[St. Johns, 1940–69]

Probability	Dates for given probability and temperature				
	16° F or lower	20° F or lower	24° F or lower	28° F or lower	32° F or lower
Spring:					
1 year in 10 later than	April 4	April 12	May 2	May 13	May 28
2 years in 10 later than	March 30	April 7	April 27	May 8	May 23
5 years in 10 later than	March 20	March 28	April 17	April 28	May 13
Fall:					
1 year in 10 earlier than	November 11	October 29	October 19	October 2	September 17
2 years in 10 earlier than	November 16	November 3	October 14	October 7	September 22
5 years in 10 earlier than	November 27	November 14	November 4	October 18	October 3

TABLE 13.—*Probability of snow cover of specified depth before given dates* [1]

[At St. Johns. Based on depth of snow cover at time of afternoon observation]

Probability	Depth of snow cover			
	1 inch	3 inches	6 inches	12 inches
5 percent	November 14	November 10	November 15	December 24
10 percent	November 11	November 18	November 28	January 11
30 percent	November 23	December 6	December 24	
50 percent	December 2	December 19	January 5	
70 percent	December 11	January 1	February 4	
90 percent	December 23	January 19		

[1] See Michigan Snowfall Statistics: First 1-, 3-, 6-, 12-inch depths. June 1968.

Michigan is on the northeast fringe of the midwest tornado belt. There has been an average of 10 tornadoes per year since 1950. Since 1900, only 11 tornadoes are known to have touched down in the county.

Evaporation from the class "A" pan during the crop season averages about 35.0 inches for the county, based on data taken in East Lansing. Because potential evaporation exceeds the average precipitation during the growing season by 92 percent, soil moisture replenishment during fall and winter months plays an important role in the success of agriculture in the county. While drought may be periodically experienced, only 6 percent of the time will drought conditions reach the extreme severity indicated by the Palmer Drought Index.

Snowfall averages 37.4 inches per year, but varies from a high of 76.8 inches recorded during the period 1951–52, to a low of 16.2 inches during the period 1948–49. The heaviest snowfall in a single day, 20.0 inches, occurred January 27, 1967. See table 13 for probability of snow cover of selected depths before given dates. Measurable amounts of snow usually fall each month from October through May. St. Johns averages 67 days per season with 1 inch or more of snow on the ground.

The nearest National Weather Service station at which records of wind, cloudiness, and humidity are kept is at Lansing Capitol City Airport. Based on 15 years of record, the average annual windspeed is 10.4 miles per hour from the south. The month with the highest average windspeed is January when the windspeed is 12.3 miles per hour from the south-southwest. The second highest is April when it is 12.0 miles per hour from the west. August has the lowest average windspeed of 8.1 miles per hour from the south. July is the second lowest with windspeed of 8.4 miles per hour also from the south. The fastest 1-minute sustained windspeed was 63 miles per hour from the southeast in June 1963.

Cloudy days are most common late in fall and early in winter, and are least common late in spring and in summer. Based upon 19 years of record, December averages 21 cloudy days, 7 partly cloudy days, and 3 clear days. August averages 9 cloudy days, 11 partly cloudy days, and 11 clear days. The annual average of percent of possible sunshine is 53 percent. The aver-

age relative humidity at 1:00 p.m., based on 10 years of record, ranges from 53 percent in May to 77 percent in December.

Physiography

This county is in the eastern lake section of the Central Lowland physiographic province of the United States. The surface features, for the most part, result from the Wisconsin, or latest glacial period. The glacial ice that once covered the State melted about 8,000 to 12,000 years ago. As the ice melted, a covering of raw soil material was left on the surface. The thickness of this glacial deposit ranges from less than 10 feet, in parts of Eagle Township, to several hundred feet.

The present land surface of the county consists of nearly level to rolling glacial plains and moraines. Old lakebed plains extending westward from Saginaw Bay make up a small area in the northeastern part. Areas of nearly level soils occur on these old lake plains, till plains, and outwash plains, but the greater part of the county is characterized by low undulations, which grade into shallow depressions with only slight changes in elevation. Long steep slopes are uncommon. Numerous swampy depressions and small lakes occur in the more rolling country, especially in the southeastern part of the county. Old glacial valleys, ranging in depth from less than 20 to 60 feet, and from a few hundred yards to 3 miles in width, traverse the county in an east-west direction. The Maple River, Hayworth Creek, Stony Creek, and Looking Glass River in these valleys have not greatly altered the original surface either by dissection or by deposition. The larger streams have very few tributaries. Exceptions occur in the valleys of the Grand and Looking Glass Rivers, but even here sharp dissection is restricted to a strip, in most places less than 1 mile wide, adjacent to the respective river valleys. As a result of this weak development of the natural drainage systems, numerous large and small areas of wet land occur both as depressions and as nearly level and gently sloping plains.

The average elevation of the county is slightly less than 800 feet above sea level and 200 feet above the level of Lake Michigan. A maximum elevation of about 900 feet is reached in the southern part of Bath Township and a minimum of less than 670 feet in the Maple River Valley of western Lebanon Township. Chandler Marsh, in Bath Township, has an elevation of about 845 to 850 feet. The elevation in the vicinity of St. Johns ranges from about 800 to 850 feet; at Fowler it is about 750 feet, at DeWitt, 850 feet, and Elsie, 725 feet.[9]

Farming

The first recorded settlement in Clinton County was in 1826 at the site of the village of Maple Rapids. Numerous scattered settlements were made in most parts of the county during the period 1830–1840, and the population increased steadily.

Early agriculture was of necessity a subsistence type. Corn, potatoes, and wheat were grown for home consumption. Income sufficient for materials not produced on the land was derived from the sale of farm crops, livestock, furs, alkaline salts from wood ashes, and lumber. Settlement and agricultural growth was steady until about 1900 when a maximum area was farmed.

As lumbering began to disappear as an economic activity, the automotive industry, along with State government, and the land grant college in nearby Lansing encouraged a steady and well balanced economic growth. Transportation facilities have increased steadily. Today no community in Clinton County is without modern transportation facilities.

The total area of Clinton County is about 365,440 acres. Of this, about 78.4 percent, or 286,958 acres, is in farms. The rest is State owned land, privately owned woodland, abandoned farmland, and resort, urban, recreational, and industrial areas. Of the acreage in farms in 1969, about 225,794 acres was cropland, and 65 percent of this acreage, or 146,025 acres, was harvested. About 7 percent, or 15,357 acres, was cropland used only for pasture.

There were 1,981 farms in the county in 1969. Of these, 380 ranged from 1 to 49 acres in size; 501 were 50 to 99 acres; 849 were 100 to 259 acres; 204 were 260 to 499 acres; and 41 were 500 to 999 acres. Only 5 farms were between 1,000 and 2,000 acres in size, and 1 farm larger than 2,000 acres. The average size farm in 1969 was 149 acres.

Of the 1,981 farms in the county, 400 were dairy farms and 713 were cattle, other than dairy, and livestock farms. The rest were vegetable, field crop, general, and unclassified farms.

Corn is the chief row crop. A total of 36,841 acres of corn was harvested for grain in 1969, and 11,376 acres was cut for silage. Also harvested in 1969 was 20,896 acres of soybeans, 12,200 acres of dry beans, 18,539 acres of wheat, 11,500 acres of oats, 600 acres of barley, and 606 acres of rye.

A total of 31,336 acres was hayland in 1969. Harvested was 21,026 acres of alfalfa and alfalfa mixtures, 1,705 acres of clover or timothy, and 42 acres of other hay crops. Also in that year, alfalfa and red clover seed were grown on 800 acres; potatoes on 213 acres; tree fruits, nuts, and grapes on 484 acres; lawn grass sod on 225 acres; and vegetables harvested for sale on 599 acres. Mint, an important special crop in this county, was harvested on 2,200 acres, from which 64,611 pounds of spearmint and peppermint oil was extracted and marketed.

[9] Data on elevations from U. S. Geological Survey Maps.

References

(1) American Association of State Highway [and Transportation] Officials. 1961. Standard specifications for highway materials and methods of sampling and testing. Ed. 8, 2 vol., illus. Washington, D.C.
(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487–69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.
(3) Michigan Department of State Highways. 1970. Field manual of soil engineering. Ed. 5, 474 pp. illus.
(4) Michigan State University. 1970. Fertilizer recommendations for vegetables and field crops in Michigan. Ext. Bul. E. 550, 32 pp.
(5) United States Department of Agriculture. 1951. Soil survey manual. Agric. Handb. No. 18, 503 pp., illus.
(6) United States Department of Agriculture. 1961. Land capability classification. U.S. Dep. Agric. Handb. 210, 21 pp.

(7) United States Department of Agriculture. 1975. Soil taxonomy, a system of soil classification for making and interpreting soil surveys.
(8) United States Department of Commerce. 1967. 1969 United States Census of Agriculture; statistics for the State and Counties, Michigan. vol. 11, 419 pp.

Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim. An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	More than 9

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coat, clay skin.

Coarse fragments. Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures is difficult.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.
Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.
Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave. Unstable walls of cuts made by earthmoving equipment. The soil sloughs easily.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. Ali are free of the mottling related to wetness.
Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.
Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.
Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Excess fines. Excess silt and clay. The soil does not provide a source of gravel or sand for construction purposes.

Fast intake. The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Frost action. Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by melt water as it flows from glacial ice.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Green manure (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Habitat. The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or geographical distribution.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Leaching. The removal of soluble material from soil or other material by percolating water.

Low strength. Inadequate strength for supporting loads.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is greater than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous areas. Areas that have little or no natural soil, are too nearly inaccessible for orderly examination, or cannot otherwise be feasibly classified.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—few, common, and many; size—fine, medium, and coarse; and contrast—faint, distinct, and prominent. The size measurements are of the diameter along the greatest dimension. Fine indicates less than 5 millimeters (about 0.2 inch); medium, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and coarse, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material mixed with mineral soil material. The content of organic matter is more than 20 percent.

Munsell notation. A designation of color by degrees of the three single variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Percolation. The downward movement of water through the soil.

Percs slowly. The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are very slow (less than 0.06 inch), slow (0.06 to 0.20 inch), moderately slow (0.2 to 0.6 inch), moderate (0.6 to 2.0 inches), moderately rapid (2.0 to 6.0 inches), rapid (6.0 to 20 inches), and very rapid (more than 20 inches).

Phase, soil. A subdivision of a soil series or other unit in the soil classification system based on differences in the soil that affect its management. A soil series, for example, may be divided into phases on the bases of differences in slope, stoniness, thickness, or some other characteristic that affects management. These differences are too small to justify separate series.

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Piping. Formation by moving water of subsurface tunnels or pipelike cavities.

Poor outlets. Surface or subsurface drainage outlets difficult or expensive to install.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH		pH
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called groundwater runoff or seepage flow from ground water.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slow intake. The slow movement of water into the soil.

Slow refill. The slow filling of ponds, resulting from restricted permeability in the soil.

Soil. A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: very coarse sand (2.0 millimeters to 1.0 millimeter); coarse sand (1.0 to 0.5 millimeter); medium sand (0.5 to 0.25 millimeter); fine sand (0.25 to 0.10 millimeter); very fine sand (0.10 to 0.05 millimeter); silt (0.005 to 0.002 millimeter); and clay (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are either single grained (each grain by itself, as in dune sand) or massive (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use or management.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer. Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Unstable fill. Risk of caving or sloughing in banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but the limited geographic soil area does not justify creation of a new series.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1978— 223-760/58

Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at (800) 457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

Nondiscrimination Policy

The U.S. Department of Agriculture (USDA) prohibits discrimination against its customers, employees, and applicants for employment on the basis of race, color, national origin, age, disability, sex, gender identity, religion, reprisal, and where applicable, political beliefs, marital status, familial or parental status, sexual orientation, whether all or part of an individual's income is derived from any public assistance program, or protected genetic information. The Department prohibits discrimination in employment or in any program or activity conducted or funded by the Department. (Not all prohibited bases apply to all programs and/or employment activities.)

To File an Employment Complaint

If you wish to file an employment complaint, you must contact your agency's EEO Counselor (http://directives.sc.egov.usda.gov/33081.wba) within 45 days of the date of the alleged discriminatory act, event, or personnel action. Additional information can be found online at http://www.ascr.usda.gov/complaint_filing_file.html.

To File a Program Complaint

If you wish to file a Civil Rights program complaint of discrimination, complete the USDA Program Discrimination Complaint Form, found online at http://www.ascr.usda.gov/complaint_filing_cust.html or at any USDA office, or call (866) 632-9992 to request the form. You may also write a letter containing all of the information requested in the form. Send your completed complaint form or letter by mail to U.S. Department of Agriculture; Director, Office of Adjudication; 1400 Independence Avenue, S.W.; Washington, D.C. 20250-9419; by fax to (202) 690-7442; or by email to program.intake@usda.gov.

Persons with Disabilities

If you are deaf, are hard of hearing, or have speech disabilities and you wish to file either an EEO or program complaint, please contact USDA through the Federal Relay Service at (800) 877-8339 or (800) 845-6136 (in Spanish).

If you have other disabilities and wish to file a program complaint, please see the contact information above. If you require alternative means of communication for program information (e.g., Braille, large print, audiotape, etc.), please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

Supplemental Nutrition Assistance Program

For additional information dealing with Supplemental Nutrition Assistance Program (SNAP) issues, call either the USDA SNAP Hotline Number at (800) 221-5689, which is also in Spanish, or the State Information/Hotline Numbers (http://directives.sc.egov.usda.gov/33085.wba).

All Other Inquires

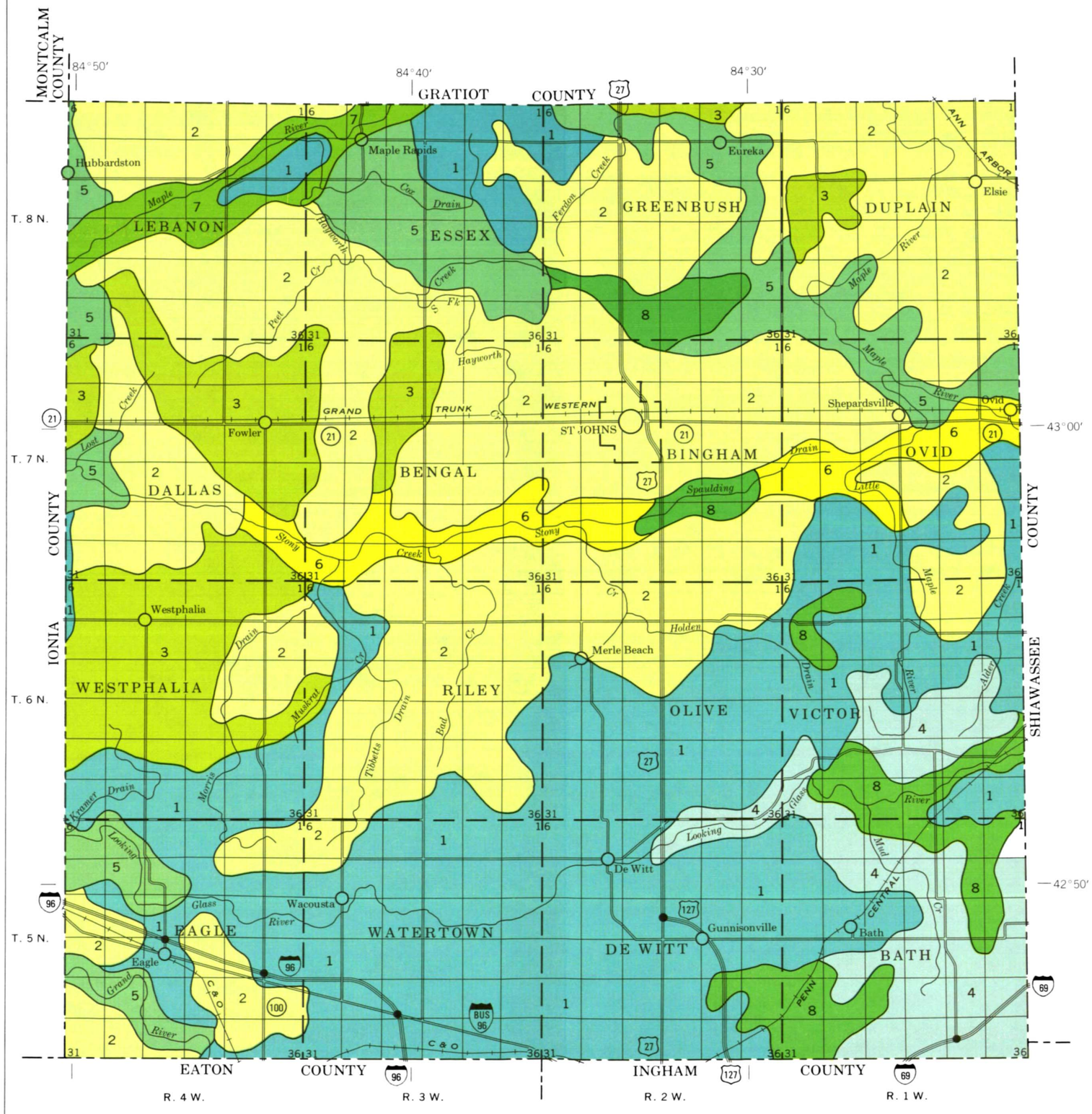
For information not pertaining to civil rights, please refer to the listing of the USDA Agencies and Offices (http://directives.sc.egov.usda.gov/33086.wba).

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
MICHIGAN AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
CLINTON COUNTY, MICHIGAN

Scale 1:190,080
1 0 1 2 3 4 Miles

N



SOIL ASSOCIATIONS

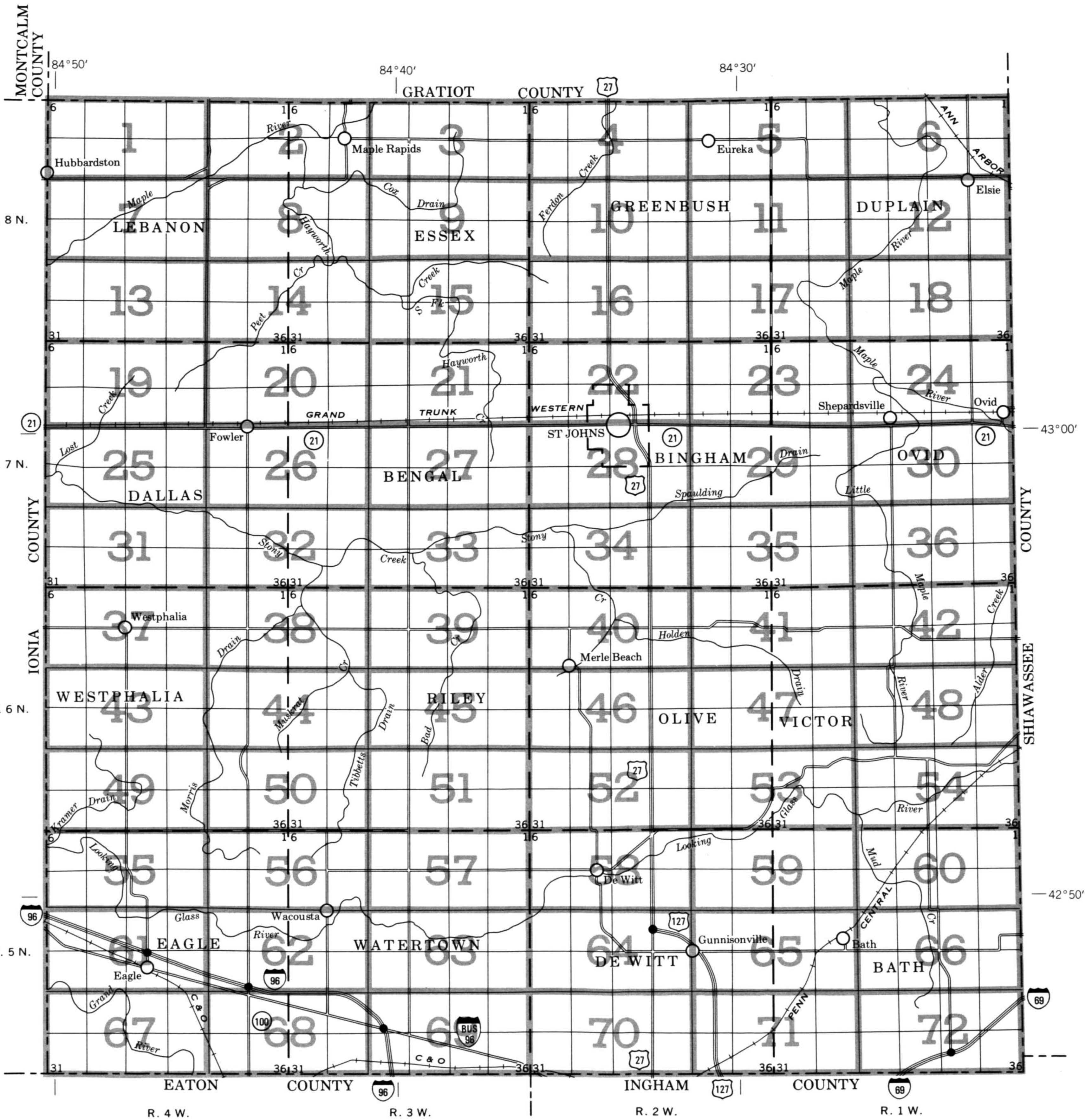
1. Marlette-Capac-Parkhill association: Well drained to very poorly drained, nearly level to steep sandy loams to clay loams on moraines and till plains
2. Capac-Parkhill-Marlette association: Very poorly drained to well drained, nearly level and gently sloping loams on till plains
3. Blount-Sims-Morley association: Very poorly drained to well drained, nearly level to sloping loams and silty clay loams on till plains and moraines
4. Boyer-Marlette-Houghton association: Well drained and moderately well drained, gently sloping to steep loamy sands to loams on moraines and very poorly drained muck in depressions
5. Boyer-Wasepi-Spinks association: Well drained and somewhat poorly drained, nearly level to moderately steep loamy sands and sandy loams on outwash plains, on terraces, and in old glacial drainageways
6. Sebewa-Matherton-Boyer association: Very poorly drained to somewhat poorly drained, nearly level loams in depressions and well drained, gently sloping loamy sands on terraces
7. Sloan-Houghton-Cohoctah association: Poorly drained and very poorly drained, nearly level loams and muck on flood plains
8. Houghton-Gilford-Adrian association: Very poorly drained, nearly level muck and sandy loams in old lake basins and in depressed drainageways

Compiled 1977

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



N

INDEX TO MAP SHEETS
CLINTON COUNTY, MICHIGAN

Scale 1:190,080

1 0 1 2 3 4 Miles

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

The first capital letter is the initial one of the soil name. The lower case letter that follows separates mapping units having names that begin with the same letter, except that it does not separate sloping or eroded phases. The second capital letter indicates the class of slope. Symbols without a slope letter are for soils that have a slope range of 0 to 2 percent. A final number 3 in the symbol indicates that the soil is severely eroded.

SYMBOL	NAME
Ad	Adrian muck
BdA	Blount loam, 0 to 2 percent slopes
BdB	Blount loam, 2 to 6 percent slopes
Bh	Borrow land
BnB	Boyer sandy loam, 0 to 6 percent slopes
BnC	Boyer sandy loam, 6 to 12 percent slopes
BoB	Boyer complex, 0 to 6 percent slopes
BoC	Boyer complex, 6 to 12 percent slopes
BoD	Boyer complex, 12 to 18 percent slopes
BoE	Boyer complex, 18 to 25 percent slopes
CaA	Capac loam, 0 to 4 percent slopes
CbB	Capac-Marlette loams, 1 to 6 percent slopes
Ce	Ceresco fine sandy loam
Ch	Cohoctah loam
Co	Colwood loam
Cr	Corunna sandy loam
Ed	Edwards muck
Gf	Gilford sandy loam
Gr	Granby loamy sand
Ho	Houghton muck
KbA	Kibbie loam, 0 to 3 percent slopes
LaB	Lapeer sandy loam, 2 to 6 percent slopes
MaB	Marlette loam, 2 to 6 percent slopes
MaC	Marlette loam, 6 to 12 percent slopes
MaD	Marlette loam, 12 to 18 percent slopes
MaE	Marlette loam, 18 to 25 percent slopes
MbC3	Marlette clay loam, 6 to 12 percent slopes, severely eroded
MbD3	Marlette clay loam, 12 to 18 percent slopes, severely eroded
MdA	Matherton loam, 0 to 3 percent slopes
MeA	Metamora-Capac sandy loams, 0 to 4 percent slopes
MhB	Metea loamy sand, 2 to 6 percent slopes
MoB	Morley loam, 2 to 6 percent slopes
MoC	Morley loam, 6 to 12 percent slopes
OaB	Oakville fine sand, 0 to 6 percent slopes
OsB	Oshtemo sandy loam, 2 to 6 percent slopes
OtA	Owosso sandy loam, 0 to 2 percent slopes
OwB	Owosso-Marlette sandy loams, 2 to 6 percent slopes
OwC	Owosso-Marlette sandy loams, 6 to 12 percent slopes
Pa	Palms muck
Pr	Parkhill loam
Sb	Sebewa loam
SeA	Selfridge loamy sand, 0 to 4 percent slopes
Sh	Shoals loam
Sm	Sims silty clay loam
SnB	Sisson fine sandy loam, 2 to 6 percent slopes
So	Sloan loam
SpB	Spinks loamy sand, 0 to 6 percent slopes
SpC	Spinks loamy sand, 6 to 12 percent slopes
StB	Spinks cobbly loamy sand, cobbly variant, 0 to 6 percent slopes
ThA	Thetford loamy sand, 0 to 3 percent slopes
Wa	Wallkill loam
WbA	Wasepi sandy loam, 0 to 3 percent slopes
Wd	Washtenaw loam

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool (Davis Airstrip; FLOOD POOL LINE)

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate (79)
- Federal (410)
- State (52)
- County, farm or ranch (378)

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small (water; W)

PITS

- Gravel pit (G.P.)
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) (Indian Mound)
- Located object (label) (Tower)
- Tank (label) (GAS)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) (CANAL)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial (water; W)
- Intermittent (int; i)

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS (CeA; FoB2)

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Borrow pit, 5 acres or less
- Sanitary land fill (S.L.F)
- Sanitary land fill, 10 acres or less

CLINTON COUNTY, MICHIGAN — SHEET NUMBER 1

CLINTON COUNTY, MICHIGAN NO. 1

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

1 870 000 FEET

590 000 FEET

R. 4 W.

GRATIOT COUNTY

T. 8 N.

IONIA COUNTY

LEBANON

(Joins sheet 2)

(Joins sheet 7)

580 000 FEET

1 885 000 FEET

N

1 Mile

5 000 Feet

Scale 1:15 840

0 1/4 1/2 3/4 1

1 000 2 000 3 000 4 000 5 000

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 2

CLINTON COUNTY, MICHIGAN NO. 3

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

1 910 000 FEET

R. 3 W.

GRATIOT COUNTY

T. 8 N.

585 000 FEET

(Joins sheet 3)

(Joins sheet 4)

(Joins sheet 9)

1 925 000 FEET

580 000 FEET

Maple River

SEWAGE LAGOON

MAPLE RAPIDS ROAD

LOWELL ROAD

3

N

1 Mile

5 000 Feet

Scale 1:15 840

4

N

GRATIOT COUNTY

R. 2 W.

1 945 000 FEET

T. 8 N.

485 000 FEET

(Joins sheet 3)

(Joins sheet 5)

(Joins sheet 10)

580 000 FEET

1 930 000 FEET

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks are based on Michigan coordinate system, south zone (transverse Mercator)

CLINTON COUNTY, MICHIGAN NO 4

CLINTON COUNTY, MICHIGAN NO. 5

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

1 950 000 FEET

R. 2 W. | R. 1 W.

GRATIOT COUNTY

T. 8 N.

585 000 FEET

580 000 FEET

1 965 000 FEET

(Joins sheet 4)

(Joins sheet 6)

(Joins sheet 11)

GREENBUSH

DUPLAIN

Eureka

GRATIOT ROAD

MAPLE RAPIDS ROAD

OAK ROAD

CHANDLER CREEK

Fisherman

5

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

CLINTON COUNTY, MICHIGAN — SHEET NUMBER 6

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO 6

CLINTON COUNTY, MICHIGAN NO. 7

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

7

N

1 Mile

5 000 Feet

Scale 1:15 840

1 870 000 FEET

580 000 FEET

R. 4 W.

T. 8 N.

IONIA COUNTY

(Joins sheet 1)

(Joins sheet 8)

(Joins sheet 13)

1 885 000 FEET

570 000 FEET

CaA

MAPLE RIVER STATE GAME AREA

MAPLE RIVER

STONE ROAD

GRANGE ROAD

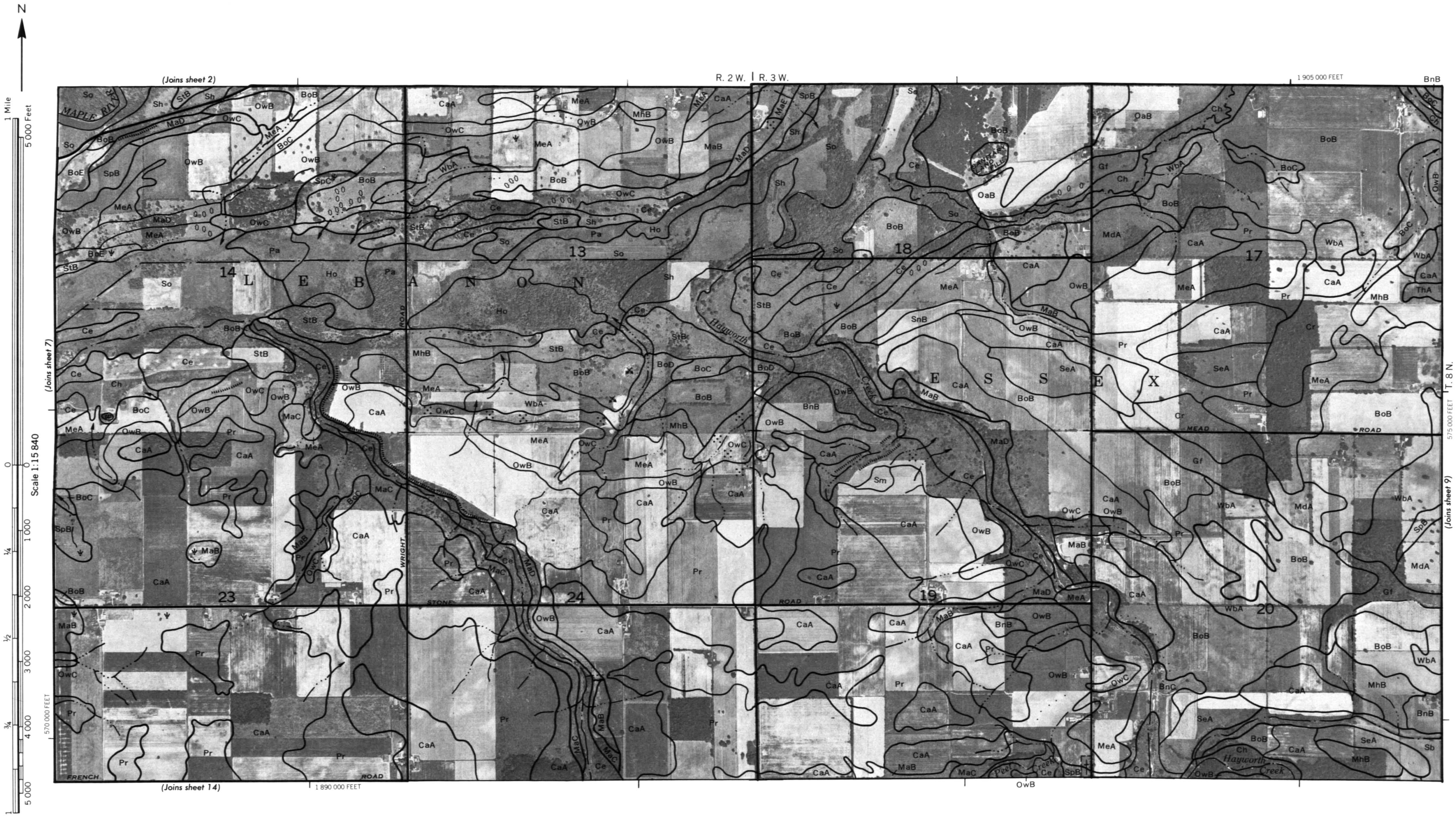
FRENCH ROAD

BELOIT ROAD

18 17 16 15

19 20 21 22

8



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

9

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

10

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 10

CLINTON COUNTY, MICHIGAN NO. 11

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

1 950 000 FEET

R. 2 W. | R. 1 W.

(Joins sheet 5)

T. 8 N.

575 000 FEET

(Joins sheet 10)

(Joins sheet 12)

570 000 FEET

1 965 000 FEET

(Joins sheet 17)

GREEN BUSH

DUPLAIN

13 14 18 17 23 24 19 20

ROAD FRENCH ROAD CHANDLER ROAD

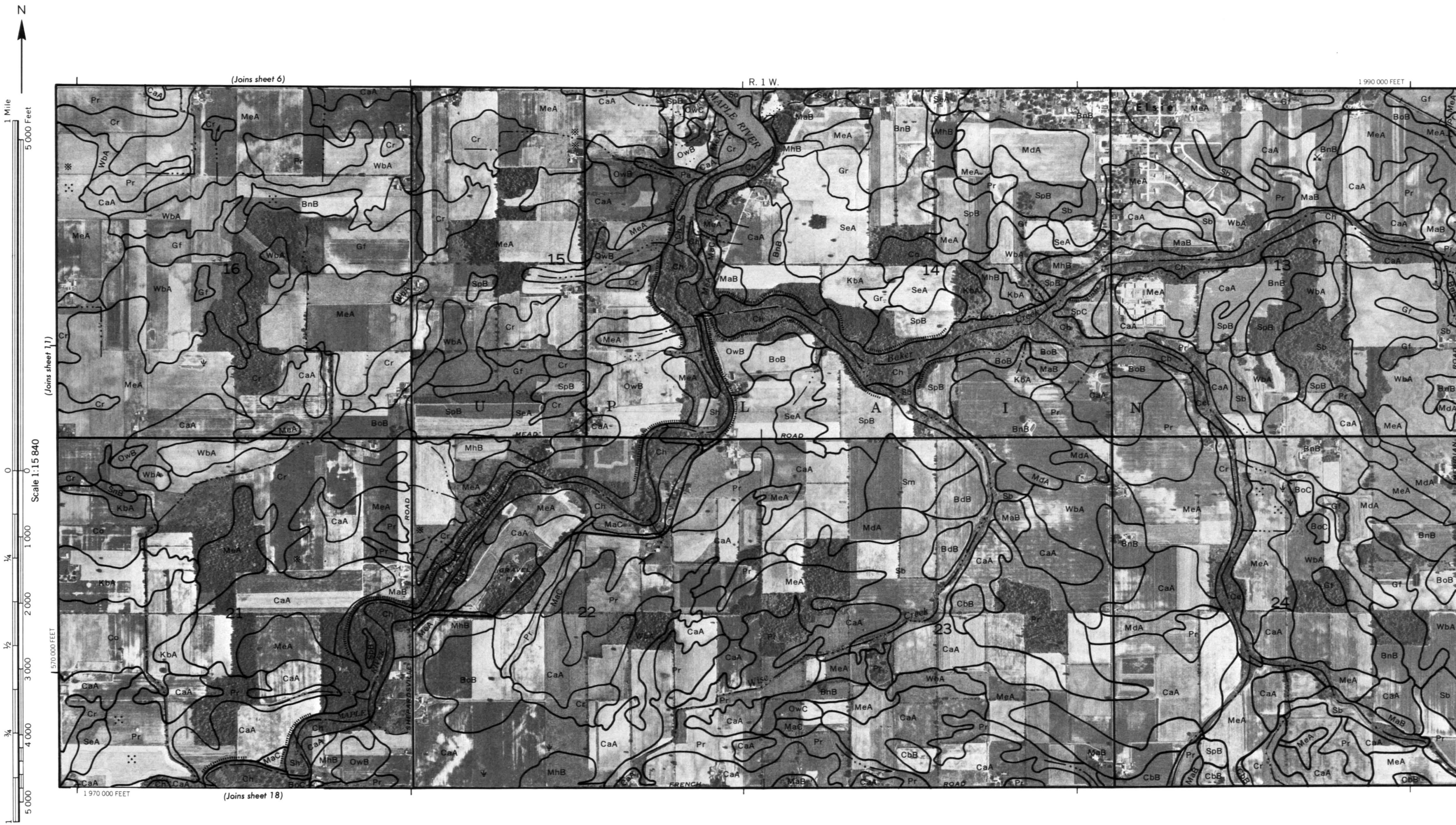
11

N

1 Mile

5 000 Feet

Scale 1:15 840



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 12

CLINTON COUNTY, MICHIGAN NO. 13

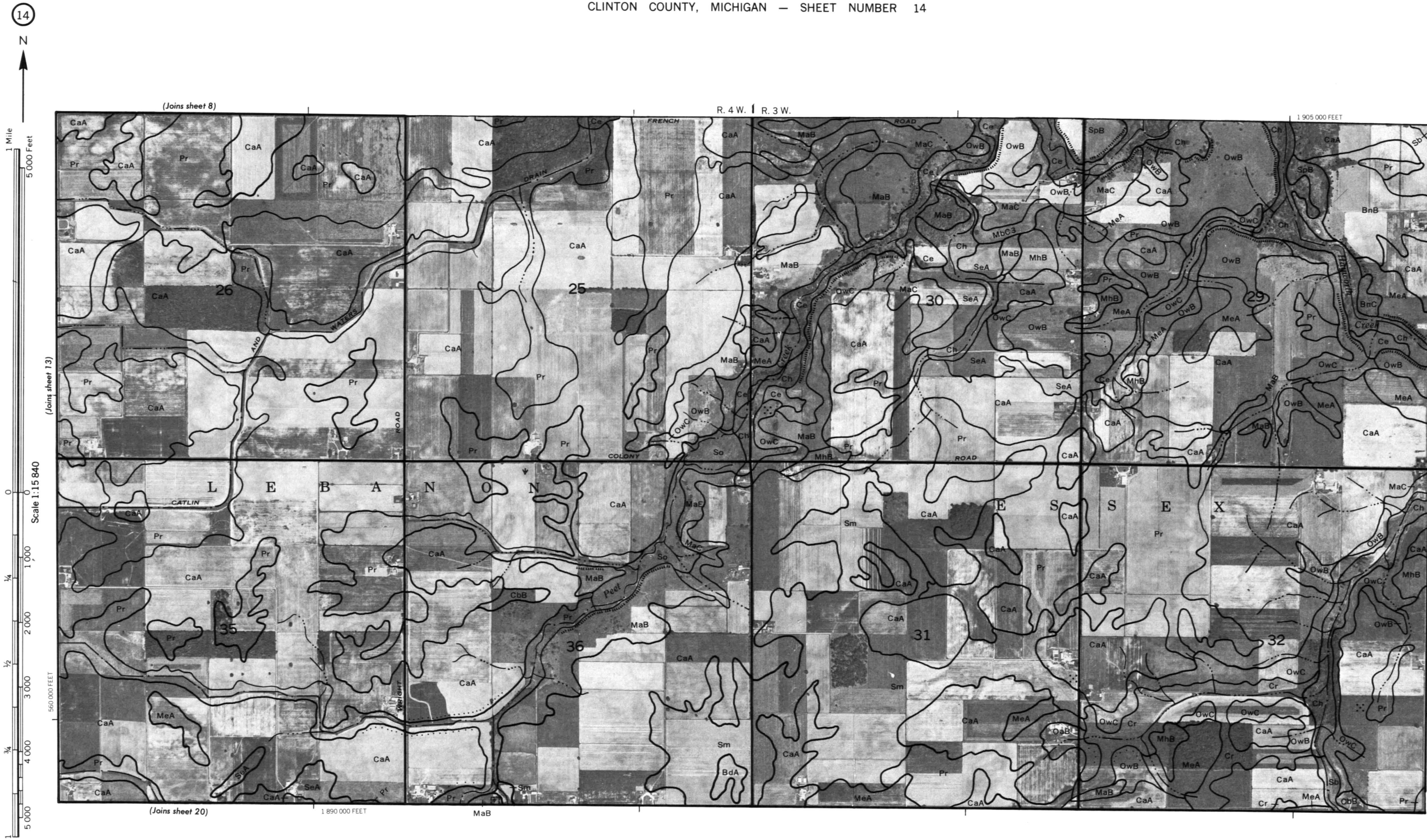
This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

13

N

1 Mile 5 000 Feet

Scale 1:15 840



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 14

CLINTON COUNTY, MICHIGAN NO. 15

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

15

N

1 910 000 FEET

R. 3 W.

(Joins sheet 9)

T. 8 N.

565 000 FEET

(Joins sheet 14)

(Joins sheet 16)

560 000 FEET

1 925 000 FEET

(Joins sheet 21)

CaA

OsB

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

16

N

1 Mile 5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

(Joins sheet 10)

R. 2 W.

1 945 000 FEET

565 000 FEET

T. 8 N.

560 000 FEET

1 930 000 FEET

(Joins sheet 15)

(Joins sheet 17)

(Joins sheet 22)

30 29 28 27 31 32 33 34

GREENBUSH ROAD

COLONY ROAD

FRENCH ROAD

BORROW PIT

GRAVEL PIT

Hayworth Creek

Intermittent

water

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 16

CLINTON COUNTY, MICHIGAN NO. 17

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

17

N

1 Mile

5,000 Feet

Scale 1:15 840

1 950 000 FEET

565 000 FEET

560 000 FEET

1 965 000 FEET

R. 2 W.

R. 1 W.

T. 8 N.

(Joins sheet 11)

(Joins sheet 16)

(Joins sheet 18)

(Joins sheet 23)

GREENBUSH

DUPLAIN

RIVER

FRENCH ROAD

COLONY ROAD

CHANDLER ROAD

MAPLE

GRAVEL PIT

26 25 30 29 35 36 31 32

18

N

(Joins sheet 12)

R. 1 W.

1 990 000 FEET

(Joins sheet 17)

T. 8 N.

565 000 FEET

SHIAWASSEE COUNTY

1 970 000 FEET

(Joins sheet 24)

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 18

CLINTON COUNTY, MICHIGAN NO. 19

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

19

N

1 Mile 5 000 Feet

0 0 15 840

Scale 1:15 840

¼ 1 000

½ 2 000

¾ 3 000

1 4 000

1¼ 5 000

20

N

(Joins sheet 14)

R. 4 W. | R. 3 W.

1 905 000 FEET

(Joins sheet 19)

(Joins sheet 21)

(Joins sheet 26)

1 890 000 FEET

555 000 FEET

550 000 FEET

T. 7 N.

Scale 1:15 840

1 Mile 5 000 Feet 1 000 2 000 3 000 4 000 5 000

0 ¼ ½ ¾ 1

DALLAS

BENGALI

SEWAGE LAGOON

FOWLER

WRIGHT ROAD

GRAND TRUNK WESTERN

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 20

CLINTON COUNTY, MICHIGAN NO. 21

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

1 910 000 FEET

R. 3 W.

(Joins sheet 15)

555 000 FEET

T. 7 N.

(Joins sheet 22)

(Joins sheet 20)

560 000 FEET

(Joins sheet 27)

1 925 000 FEET

21

N

1 Mile

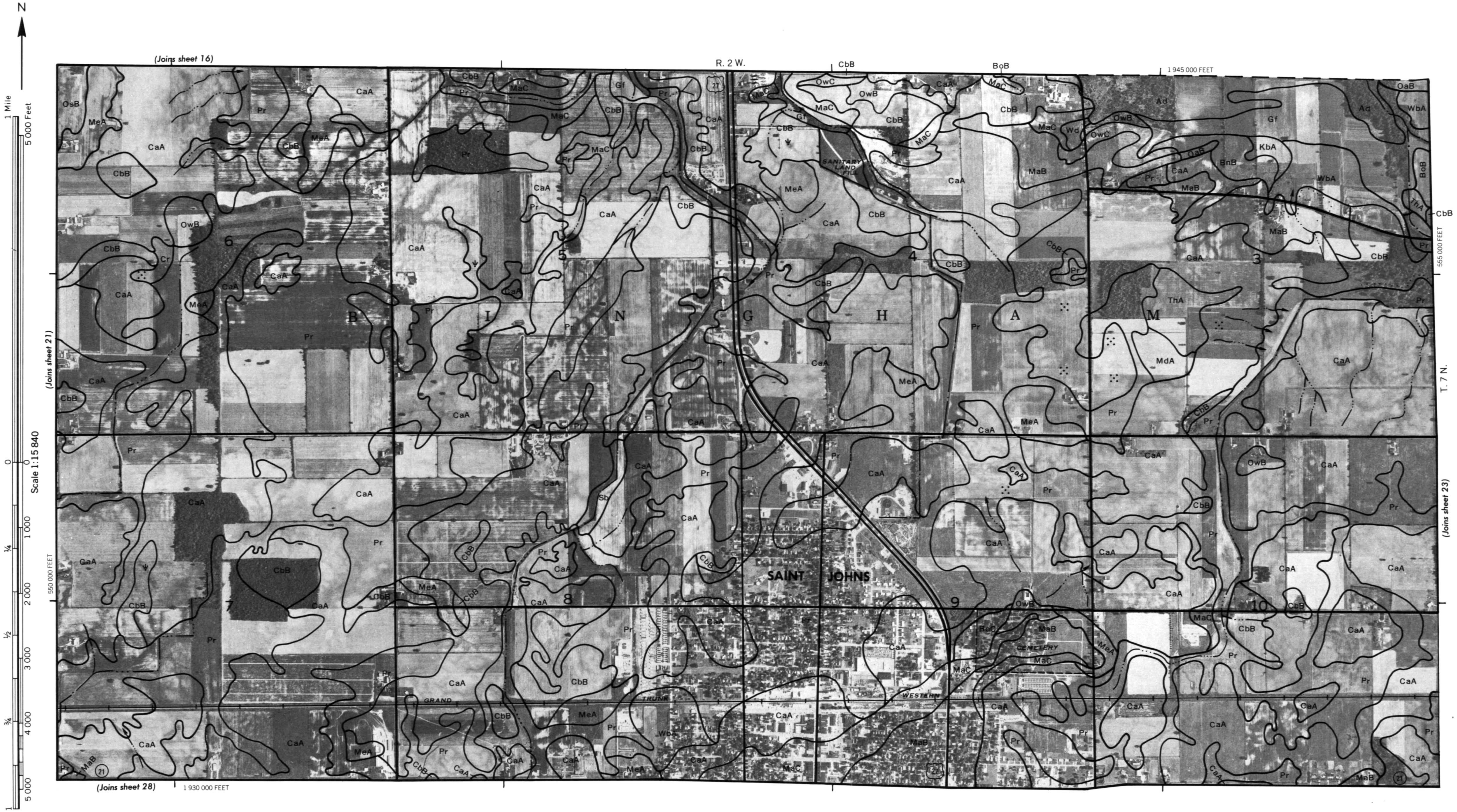
5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

CLINTON COUNTY, MICHIGAN — SHEET NUMBER 22



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 22

CLINTON COUNTY, MICHIGAN NO. 23

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

23

N

1 950 000 FEET

R. 2 W. | R. 1 W.

(Joins sheet 17)

555 000 FEET

T. 7 N.

BRIGHAM

(Joins sheet 22)

CHANDLER ROAD

TRUNK

GRAND

WESTERN

Maple River

1 965 000 FEET

550 000 FEET

(Joins sheet 24)

(Joins sheet 29)

1 Mile

5 000 Feet

Scale 1:15 840

1/4 0 1/4 1/2 3/4 1

1 000 0 1 000 2 000 3 000 4 000 5 000

(24)

N

(Joins sheet 18)

R. 1 W.

1 990 000 FEET

555 000 FEET

T. 7 N.

(Joins sheet 23)

550 000 FEET

1 970 000 FEET

(Joins sheet 30)

SHIAWASSEE COUNTY

1 Mile 5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 24

CLINTON COUNTY, MICHIGAN NO. 25

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and division points, if shown, are approximately positioned.

25

N

1 870 000 FEET

R. 4 W.

(Joins sheet 19)

545 000 FEET

T. 7 N.

IONIA COUNTY

(Joins sheet 26)

540 000 FEET

(Joins sheet 31)

1 885 000 FEET

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 26

CLINTON COUNTY, MICHIGAN NO. 27

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

1 910 000 FEET

R. 3 W.

(Joins sheet 21)

545 000 FEET

T. 7 N.

(Joins sheet 26)

(Joins sheet 28)

1 925 000 FEET

(Joins sheet 33)

540 000 FEET

16 15 14 13

21 22 23 24

BAKER ROAD

LOWELL ROAD

PARKS ROAD

Hayworth Creek

South Fork

27

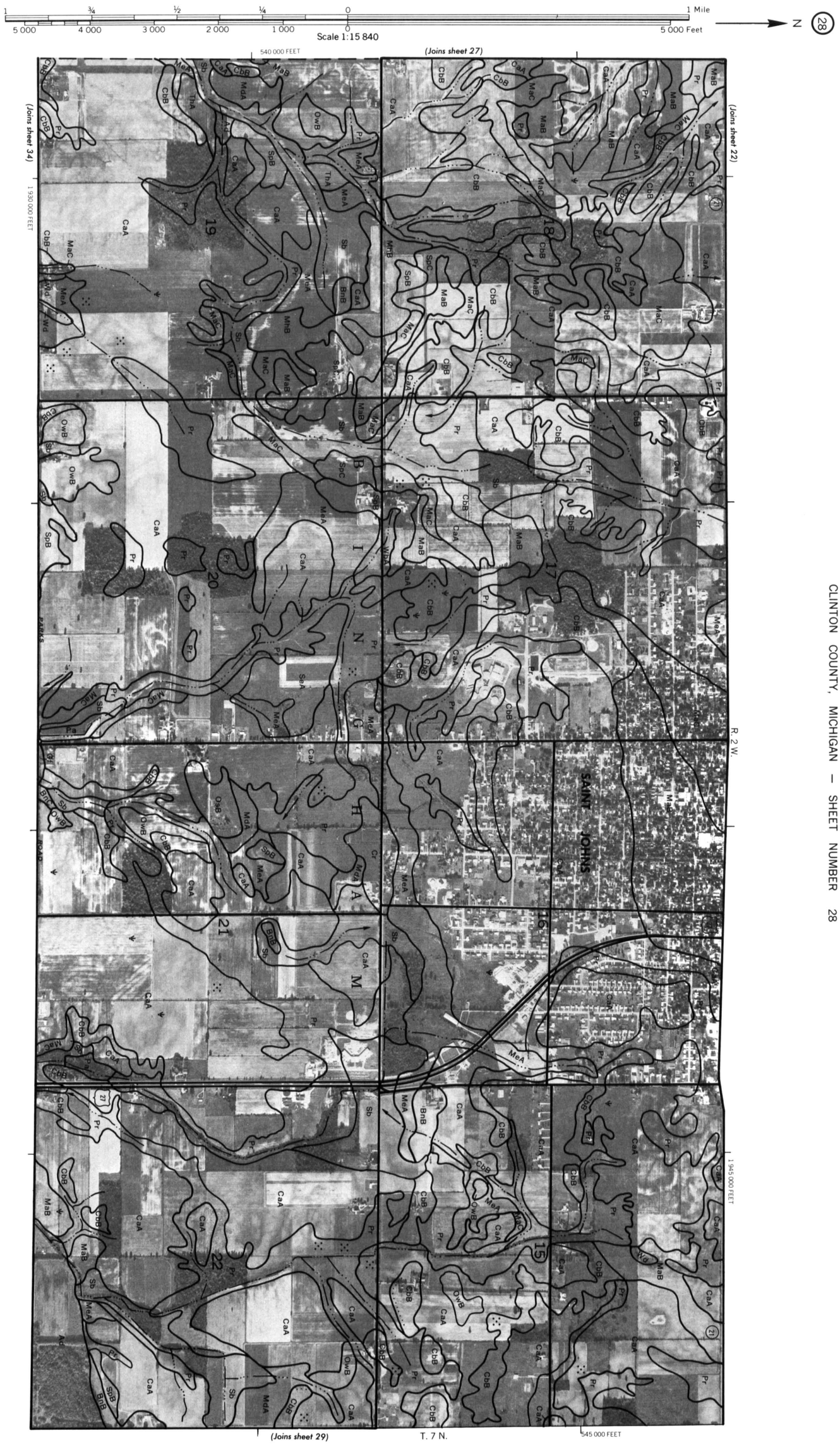
N

1 Mile

5 000 Feet

Scale 1:15 840

0 1 000 2 000 3 000 4 000 5 000



CLINTON COUNTY, MICHIGAN — SHEET NUMBER 28

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 28

29

CLINTON COUNTY, MICHIGAN NO. 29

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

1 950 000 FEET

545 000 FEET

R. 2 W. | R. 1 W.

(Joins sheet 23)

T. 7 N.

(Joins sheet 28)

(Joins sheet 30)

(Joins sheet 35)

1 970 000 FEET

540 000 FEET

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

30

N

1 Mile
5 000 Feet
Scale 1:15 840
0 ¼ ½ ¾ 1
0 1 000 2 000 3 000 4 000 5 000

(Joins sheet 24)

R. 1 W.

1 990 000 FEET

545 000 FEET

T. 7 N.

(Joins sheet 29)

540 000 FEET

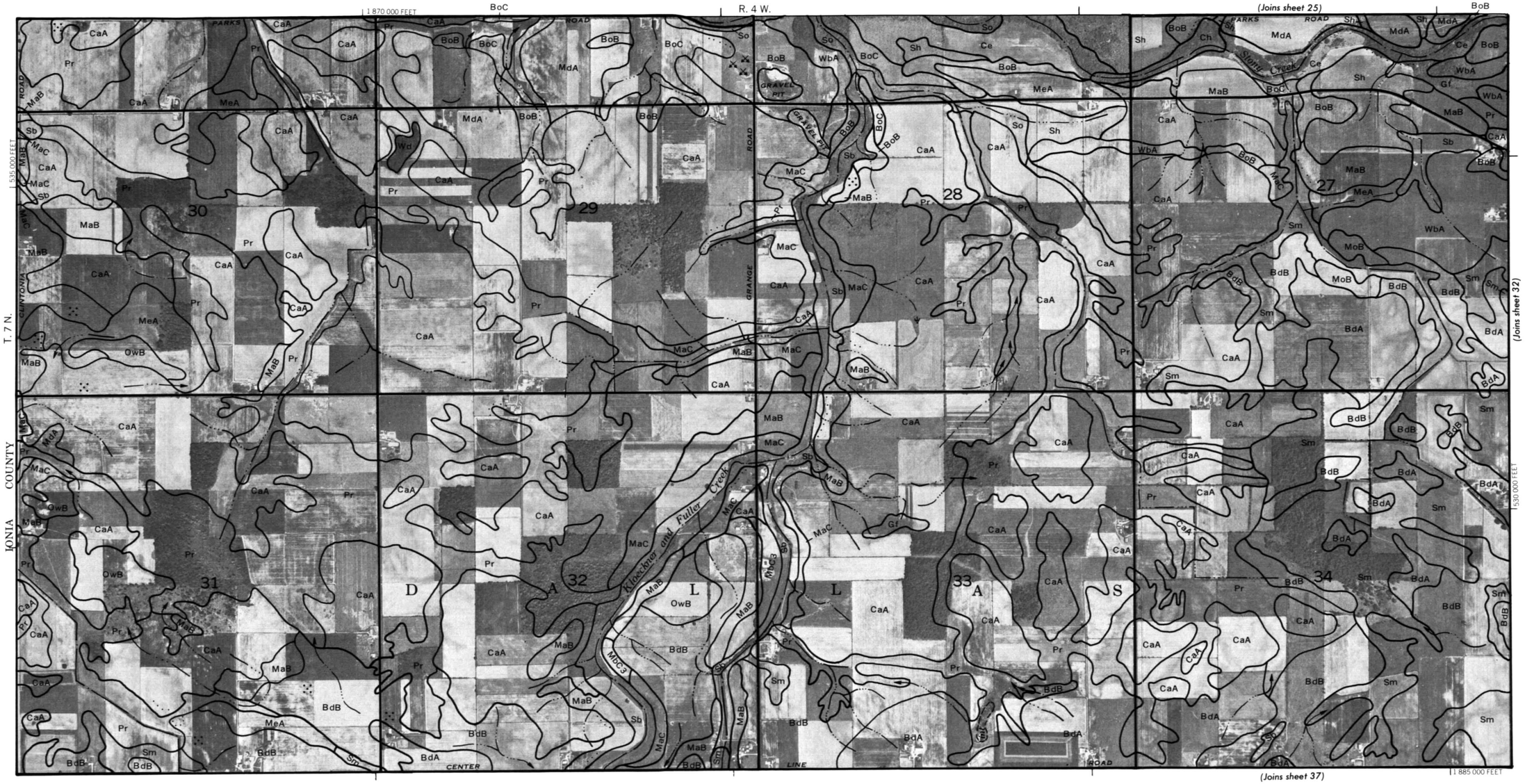
(Joins sheet 36)

1 975 000 FEET

SHIAWASSEE COUNTY

CLINTON COUNTY, MICHIGAN NO. 30

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Roads, boundaries, and land division corners, if shown, are approximately positioned.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



31

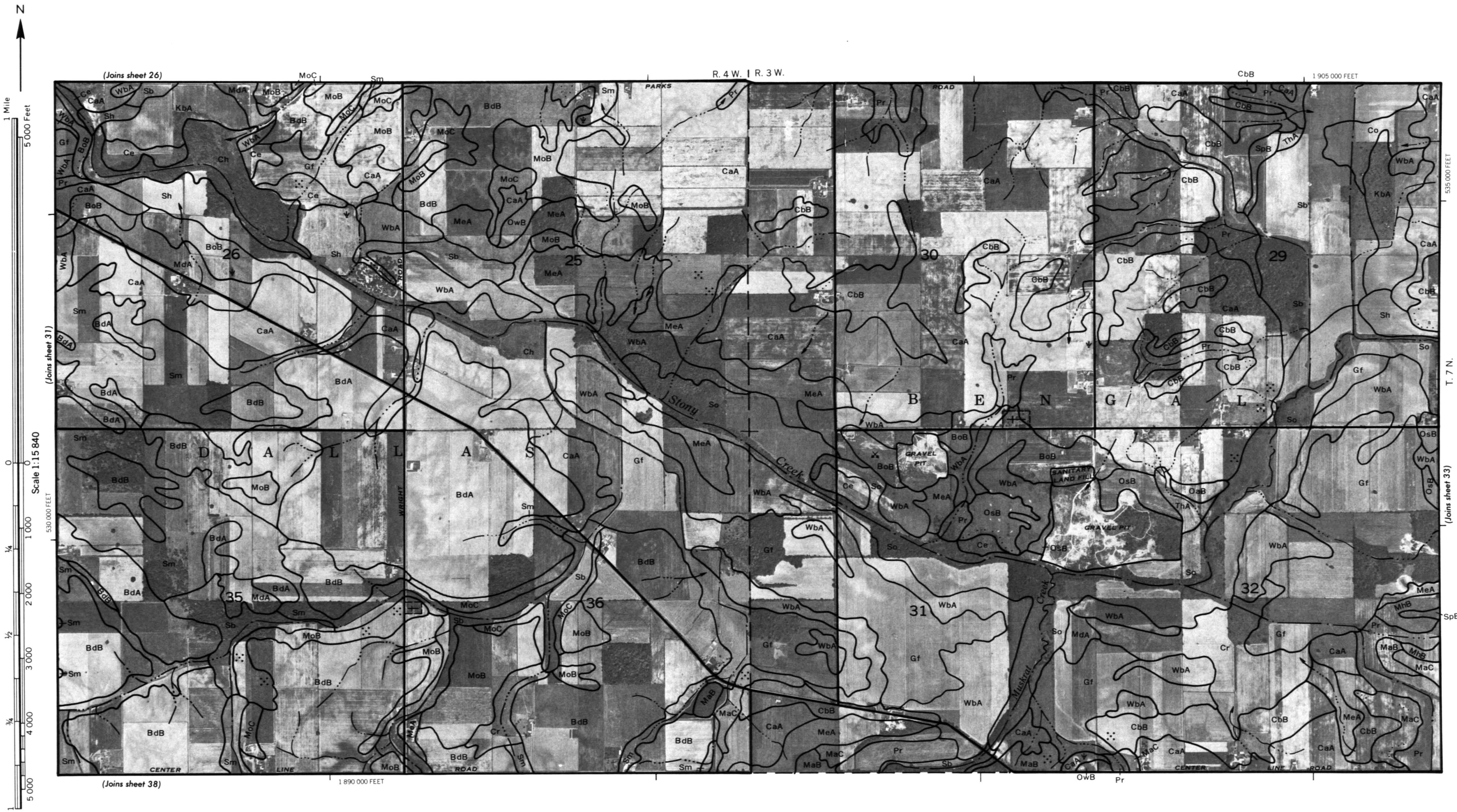
N

1 Mile

5 000 Feet

Scale 1:15 840

0 0
1/4 1 000
1/2 2 000 3 000
3/4 4 000
1 5 000



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 32

CLINTON COUNTY, MICHIGAN NO. 33

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

1 910 000 FEET

R. 3 W.

(Joins sheet 27)

535 000 FEET

T. 7 N.

(Joins sheet 32)

(Joins sheet 34)

530 000 FEET

1 925 000 FEET

(Joins sheet 39)

28 27 26 25 33 34 35 36

Stony Creek

Bad Creek

PARKS ROAD

LOWELL CARTER LINE ROAD

33

N

1 Mile

5 000 Feet

Scale 1:15 840

(34)

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

(Joins sheet 28)

R. 2 W.

1 945 000 FEET

535 000 FEET

T. 7 N.

530 000 FEET

1 930 000 FEET

(Joins sheet 33)

(Joins sheet 40)

(Joins sheet 35)

30 29 28 27 31 32 33 34

BRIDGE ROAD

SPAULDING DRAIN

Stony Creek

CENTER LINE ROAD

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 34

CLINTON COUNTY, MICHIGAN NO. 35

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

1 950 000 FEET

535 000 FEET

R. 2 W. | R. 1 W.

T. 7 N.

(Joins sheet 29)

(Joins sheet 34)

(Joins sheet 36)

(Joins sheet 41)

1 970 000 FEET

530 000 FEET

BRUSH CENTER ROAD

PARKS CORNERS ROAD

BENNINGHAM ROAD

BINGHAM

MAPLE VALLEY

35

N

1 Mile

5 000 Feet

Scale 1:15 840

0 5 000 1 000 2 000 3 000 4 000 5 000

0 ¼ ½ ¾ 1

CLINTON COUNTY, MICHIGAN — SHEET NUMBER 36

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 36

CLINTON COUNTY, MICHIGAN NO. 37

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

37

N

1 870 000 FEET

R. 4 W.

(Joins sheet 31)

525 000 FEET

T. 6 N.

IONIA COUNTY

Westphalia

CENTER ROAD

SEWAGE LAGOON

Maple Valley Cemetery

Bond Fuller Creek

JASON ROAD

GRANGE ROAD

(Joins sheet 38)

(Joins sheet 43)

520 000 FEET

1 885 000 FEET

1 Mile

5 000 Feet

Scale 1:15 840

38

N

(Joins sheet 32)

R. 4 W. | R. 3 W.

1 905 000 FEET

525 000 FEET

T. 6 N.

(Joins sheet 37)

(Joins sheet 39)

520 000 FEET

(Joins sheet 44)

1 890 000 FEET

Scale 1:15 840

1 Mile

5 000 Feet

0 0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

WESTPHALIA

RILEY

JASON

WRIGHT

ROAD

CENTER LINE

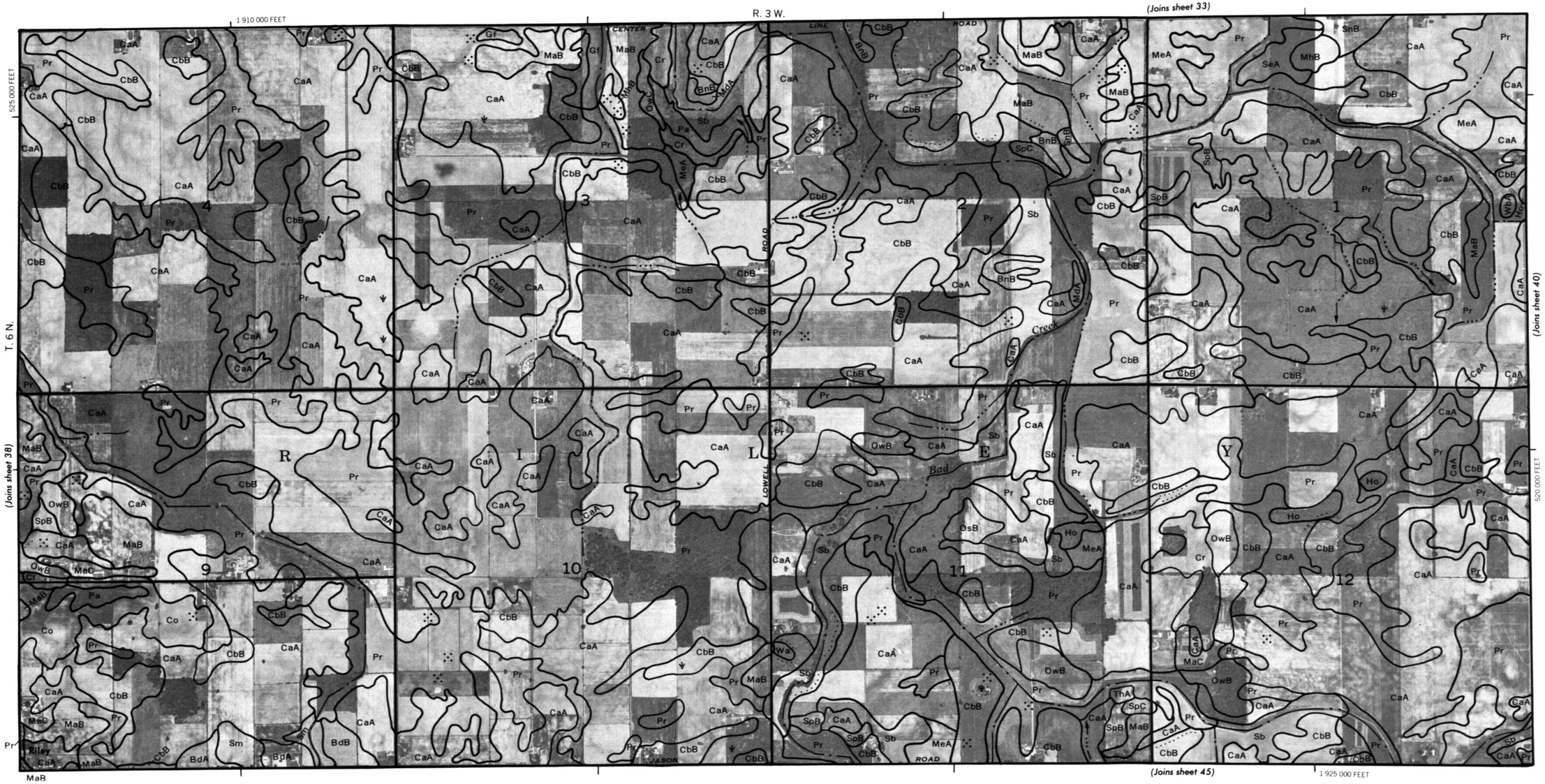
Muskrat Creek

This map is compiled on 1973 aerial photographs by the U. S. Department of Agriculture Soil Conservation Service and cooperating agencies.
Controlled grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 38

CLINTON COUNTY, MICHIGAN NO. 39

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



39

N

1 Mile
5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

40

N

(Joins sheet 34)

R. 2 W.

1 945 000 FEET

525 000 FEET

T. 6 N.

(Joins sheet 39)

(Joins sheet 41)

(Joins sheet 46)

1 930 000 FEET

Scale 1:15 840

1 Mile 5 000 Feet

0 1/4 1/2 3/4 1

520 000 FEET

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 40

CLINTON COUNTY, MICHIGAN NO. 41

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

41

N

1 Mile

5 000 Feet

Scale 1:15 840

1 950 000 FEET

525 000 FEET

520 000 FEET

1 970 000 FEET

R. 2 W. | R. 1 W.

T. 6 N.

OLIVE

VICTOR

Curtis Lake

Richmond Lake

CENTER LINE ROAD

CHANDLER ROAD

JASON ROAD

GRAVEL PIT

Intermittent

(Joins sheet 35)

(Joins sheet 40)

(Joins sheet 42)

(Joins sheet 47)

(42)

N

1 Mile 5 000 Feet

Scale 1:15 840

(Joins sheet 36)

(Joins sheet 40)

(Joins sheet 48)

R. 1 W.

1 990 000 FEET

525 000 FEET

520 000 FEET

1 975 000 FEET

T. 6 N.

SHIAWASSEE COUNTY

CLINTON COUNTY, MICHIGAN NO. 42

SLEEPY HOLLOW STATE PARK

Lake Victoria

Westchester Heights

Little Maple River

SHEPARDSVILLE ROAD

CENTER LINE ROAD

FILL LAND

GRAVEL PIT

JASON ROAD

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 43

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

43

N

1 Mile
5,000 Feet

Scale 1:15 840

1 865 000 FEET

515 000 FEET

T. 6 N.

R. 4 W.

IONIA COUNTY

CLINTON COUNTY

(Joins sheet 37)

(Joins sheet 44)

(Joins sheet 49)

510 000 FEET

1 885 000 FEET

JASON ROAD

PRATT ROAD

GRANGE ROAD

CLINTONIA ROAD

EAST PLAIN

18 17 16 15

19 20 21 22

44

N

(Joins sheet 38)

R. 4 W. | R. 3 W.

1 905 000 FEET

515 000 FEET

T. 6 N.

(Joins sheet 43)

(Joins sheet 45)

(Joins sheet 50)

1 890 000 FEET

1 Mile
5 000 Feet

Scale 1:15 840

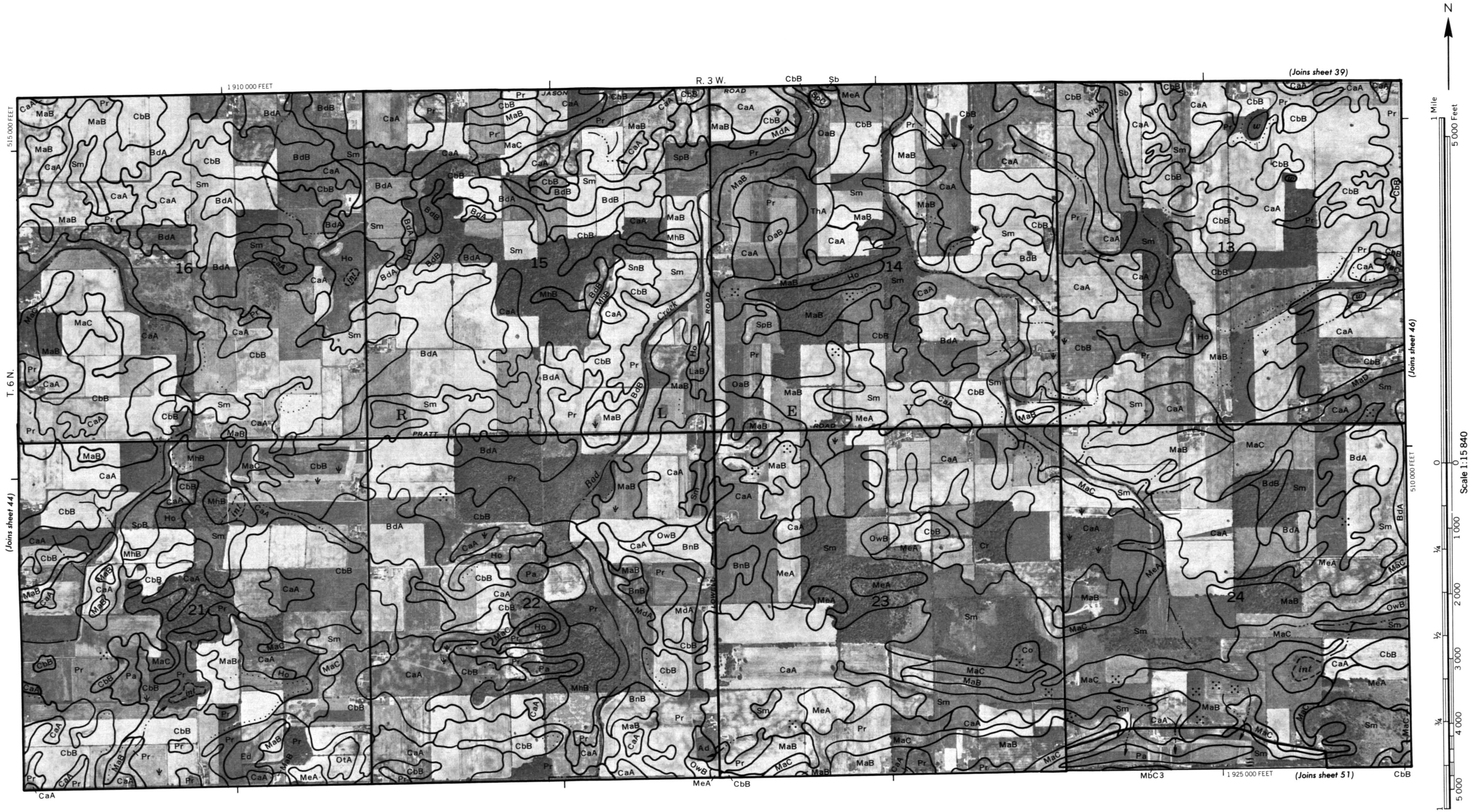
510 000 FEET

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 44



CLINTON COUNTY, MICHIGAN NO. 45

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

46

N

1 Mile 5 000 Feet

Scale 1:15 840

0 0 ¼ 1 000 ½ 2 000 ¾ 4 000 1 5 000

(Joins sheet 40)

(Joins sheet 41)

(Joins sheet 52)

(Joins sheet 47)

R. 2 W.

T. 6 N.

510 000 FEET

515 000 FEET

1 930 000 FEET

1 945 000 FEET

Muskrat Lake

Alward Lake

JASON ROAD

PRATT ROAD

OLIVE

15 16 17 19 20 21 22

This map is compiled on 1972 aerial photographs by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximate positions.

CLINTON COUNTY, MICHIGAN NO. 46

CLINTON COUNTY, MICHIGAN NO 47

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

47

N

1 950 000 FEET

515 000 FEET

R. 2 W. | R. 1 W.

T. 6 N.

(Joins sheet 46)

(Joins sheet 41)

(Joins sheet 48)

(Joins sheet 53)

510 000 FEET

1 970 000 FEET

Archer Landing Field

Mud Lake

Cedar Lake

OLIVE

VICTOR

ROAD

1 Mile

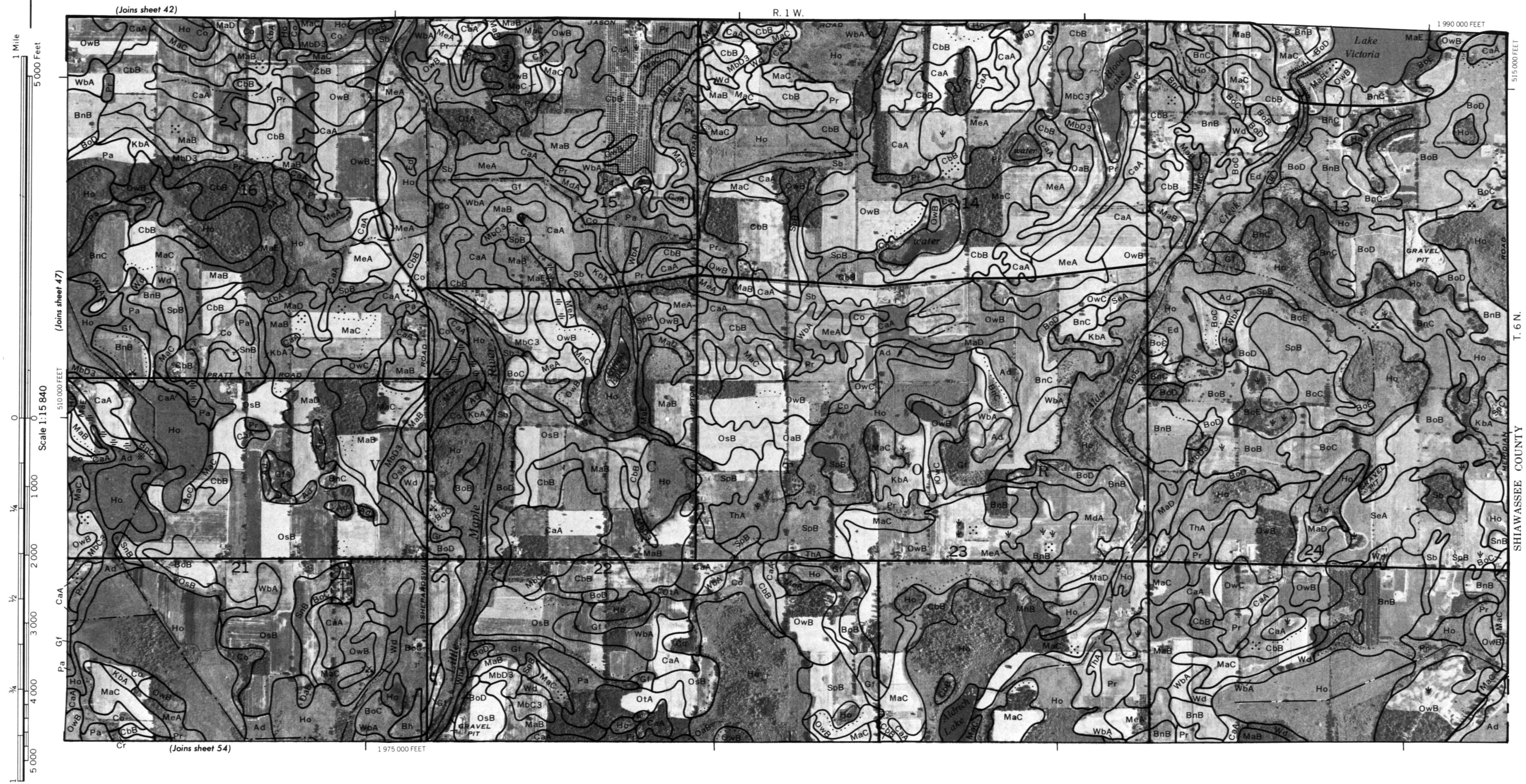
5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

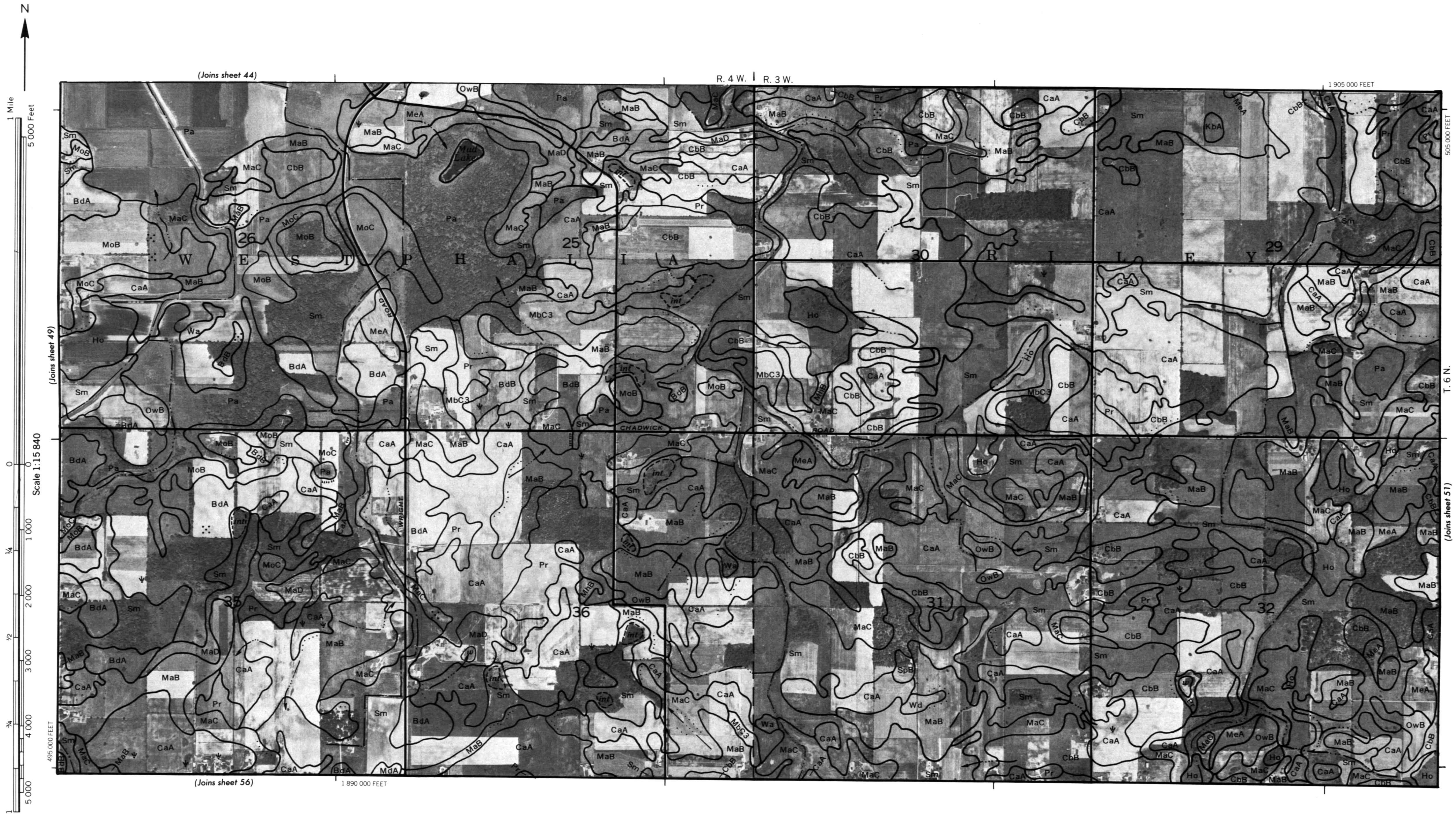
0 1 000 2 000 3 000 4 000 5 000

CLINTON COUNTY, MICHIGAN — SHEET NUMBER 48



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 49



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 50

CLINTON COUNTY, MICHIGAN NO. 51

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

1 910 000 FEET

505 000 FEET

R. 3 W.

T. 6 N.

(Joins sheet 45)

(Joins sheet 50)

(Joins sheet 52)

(Joins sheet 57)

1 925 000 FEET

495 000 FEET

CHADWICK ROAD

HOWELL ROAD

South Riley

51

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

5 000 4 000 3 000 2 000 1 000 0

52

N

1 Mile
5,000 Feet

Scale 1:15 840

(Joins sheet 46)

R. 2 W.

1 945 000 FEET

(Joins sheet 51)

(Joins sheet 53)

(Joins sheet 58)

1 930 000 FEET

495 000 FEET

500 000 FEET

T. 6 N.

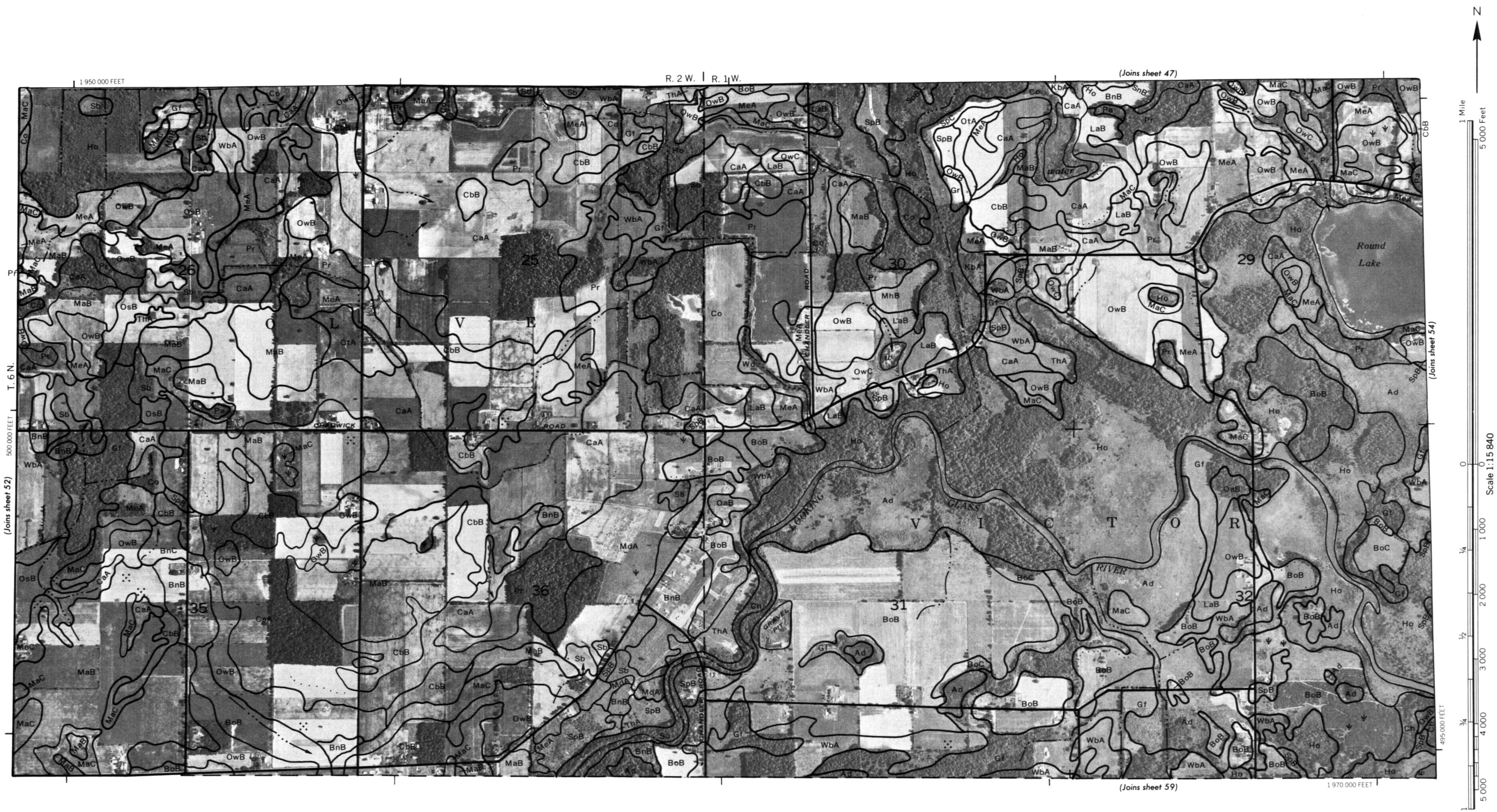
CHADWICK ROAD

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 52

CLINTON COUNTY, MICHIGAN NO. 53

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



54

N

(Joins sheet 48)

R. 1 W.

1 990 000 FEET

505 000 FEET

T. 6 N.

(Joins sheet 53)

1 Mile
5 000 Feet
Scale 1:15 840
0 0
¼ 1 000
½ 2 000
¾ 4 000
1 5 000

495 000 FEET

(Joins sheet 60)

1 975 000 FEET

SHIAWASSEE COUNTY

CLINTON COUNTY, MICHIGAN NO. 54

This map is compiled on 1971 aerial photographs by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

N

CLINTON COUNTY, MICHIGAN NO. 55

This map is compiled on 1971 aerial photographs by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

1 865 000 FEET

495 000 FEET

R. 4 W.

(Joins sheet 49)

T. 5 N.

IONIA COUNTY

(Joins sheet 56)

485 000 FEET

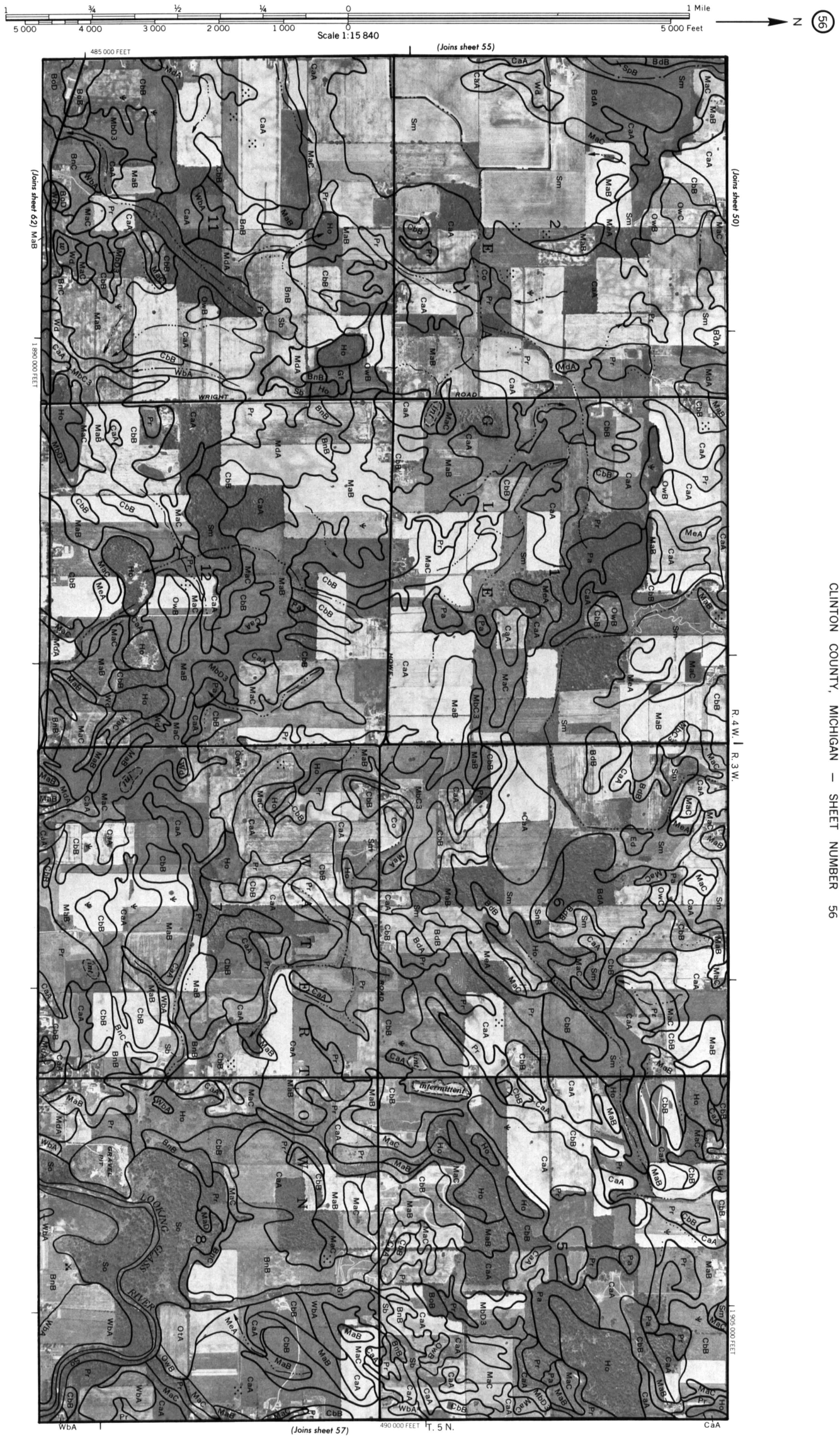
(Joins sheet 61)

1 885 000 FEET

1 Mile

5 000 Feet

Scale 1:15 840



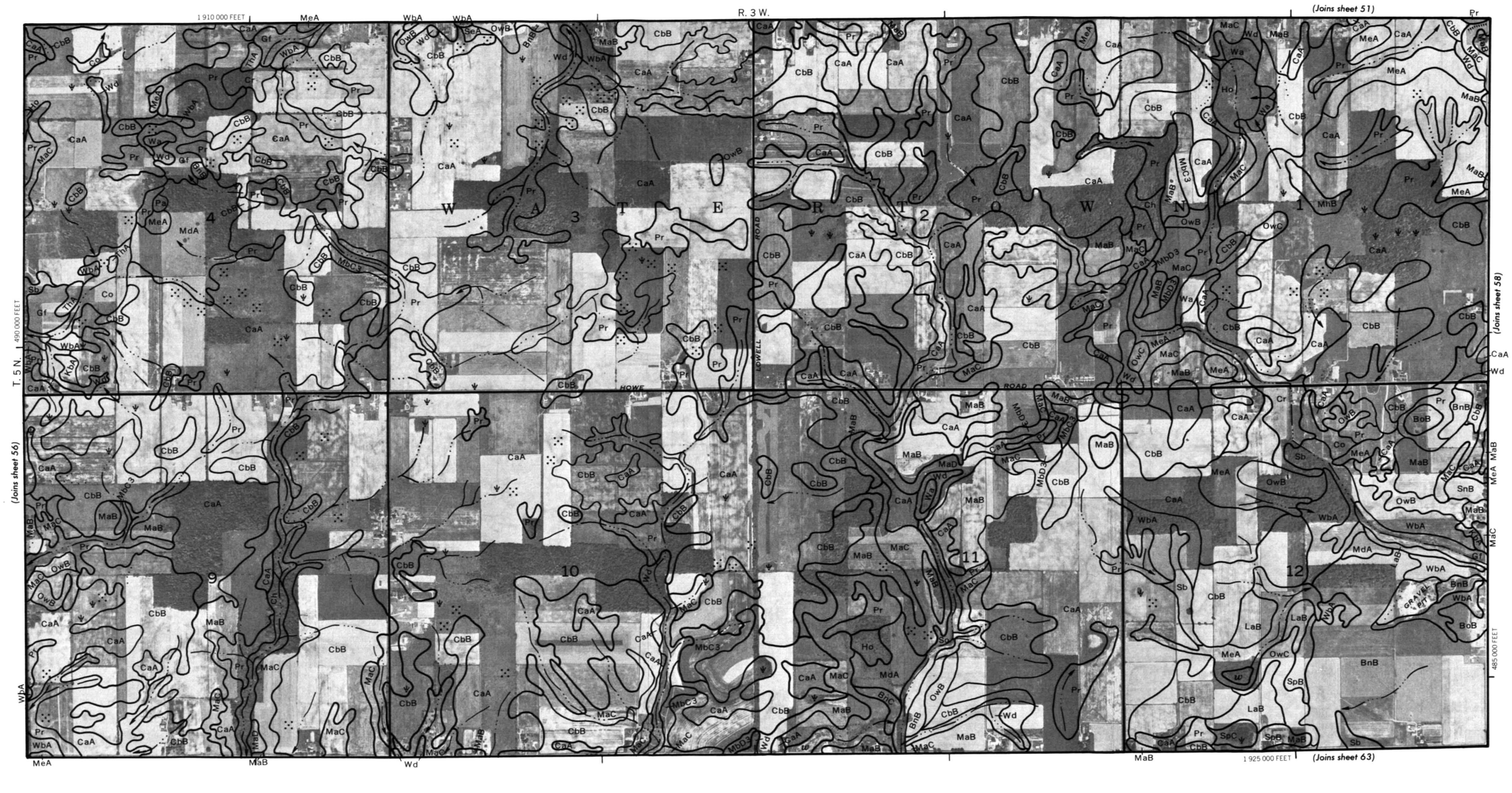
CLINTON COUNTY, MICHIGAN — SHEET NUMBER 56

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 56

CLINTON COUNTY, MICHIGAN NO. 57

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



58

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0 ¼ 1 000 ½ 2 000 ¾ 4 000 1 5 000

(Joins sheet 52)

(Joins sheet 57)

R. 2 W.

1 945 000 FEET

490 000 FEET

T. 5 N.

485 000 FEET

1 930 000 FEET

(Joins sheet 59)

(Joins sheet 64)

East De Witt

DE WITT

water

GRAVEL PIT

LANDFILL

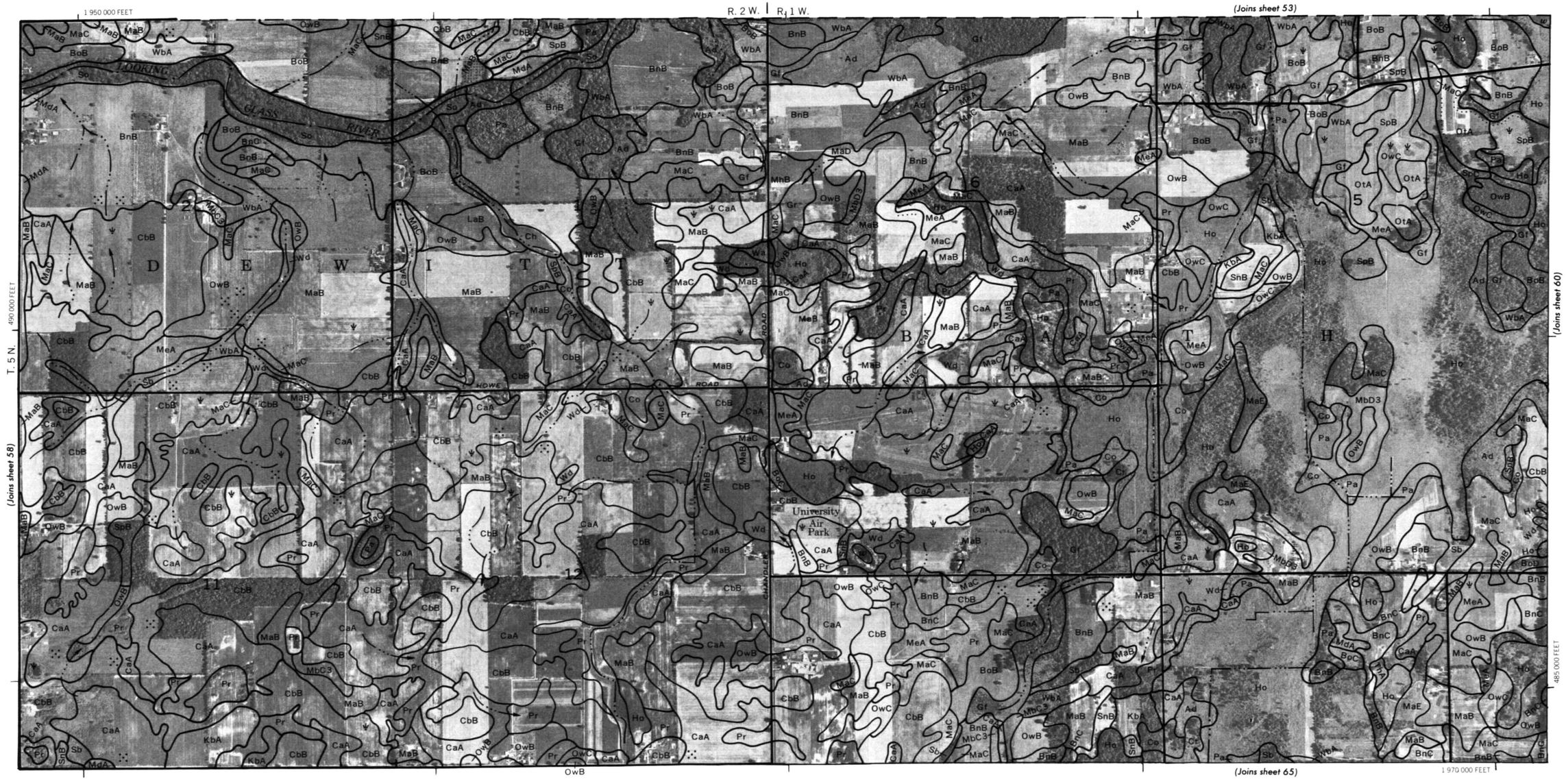
ROAD

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 58

CLINTON COUNTY, MICHIGAN NO. 59

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



CLINTON COUNTY, MICHIGAN — SHEET NUMBER 60

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 60

CLINTON COUNTY, MICHIGAN NO. 61

This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

61

N

1 Mile
5 000 Feet

Scale 1:15 840

1 865 000 FEET

R. 4 W.

(Joins sheet 55)

T. 5 N.

480 000 FEET

IONIA COUNTY

475 000 FEET

(Joins sheet 62)

(Joins sheet 67)

1 885 000 FEET

GRAVEL PIT

LOOKING GLASS RIVER

CHESAPEAKE AND OHIO

GRAND RIVER

STOLL ROAD

Eagle

EAGLE

62

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

(Joins sheet 56)

(Joins sheet 61)

R. 4 W. | R. 3 W.

1 905 000 FEET

480 000 FEET

T. 5 N.

475 000 FEET

(Joins sheet 63)

(Joins sheet 68)

1 890 000 FEET

BnB

Waccousta

WATERTOWN

EAGLE

GLASS ROAD

WRIGHT ROAD

LOOKING GLASS RIVER

GRAVEL PIT

CEMETERY

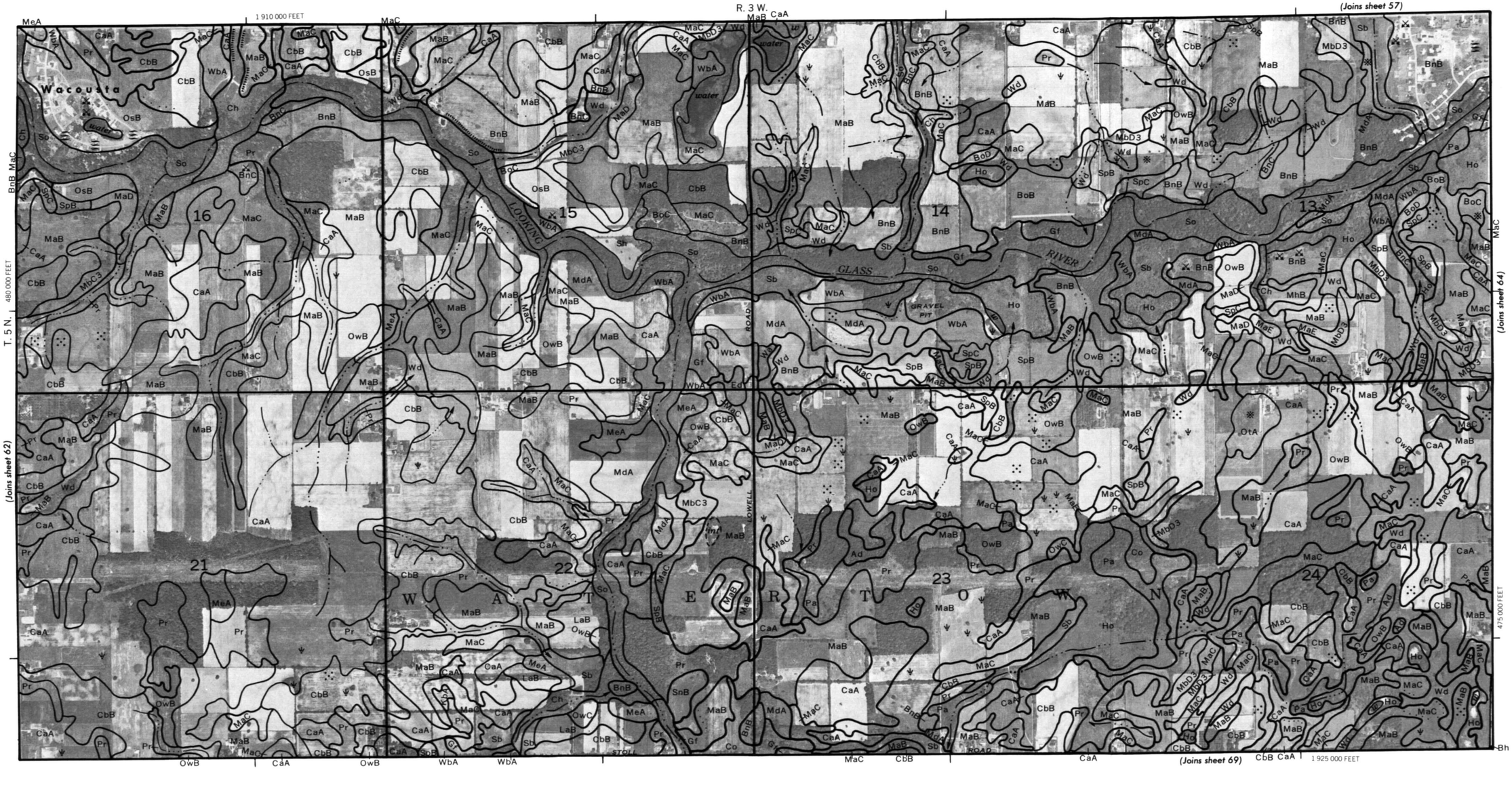
14 13 18 17 23 24 19 20

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 62

CLINTON COUNTY, MICHIGAN NO. 63

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



63

N

1 Mile 5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

64

N

1 Mile

5 000 Feet

Scale 1:15 840

(Joins sheet 58)

R. 2 W.

1 945 000 FEET

(Joins sheet 63)

475 000 FEET

1 930 000 FEET

(Joins sheet 70)

480 000 FEET

T. 5 N.

(Joins sheet 65)

DE WITT

Gunnisonville

FILL LAND

GRAVEL PIT

ROAD

DRAIN

CLINTON COUNTY, MICHIGAN NO. 64

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 65

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

65

N

1 Mile
5 000 Feet

Scale 1:15 840

1 950 000 FEET
480 000 FEET
475 000 FEET
1 970 000 FEET

R. 2 W. | R. 1 W.

T. 5 N.

(Joins sheet 59)
(Joins sheet 64)
(Joins sheet 66)
(Joins sheet 71)

Gunnisonville
Bath
CHANDLER DRAIN
REMEY DRAIN
STOLL ROAD
CHANDLER ROAD
CORPORATION
Intermittent
CONSOLIDATED

66

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0

1/4 1 000

1/2 2 000

3/4 3 000

4 000

5 000

(Joins sheet 60)

(Joins sheet 65)

(Joins sheet 72)

R. 1 W.

1 990 000 FEET

480 000 FEET

475 000 FEET

1 975 000 FEET

T. 5 N.

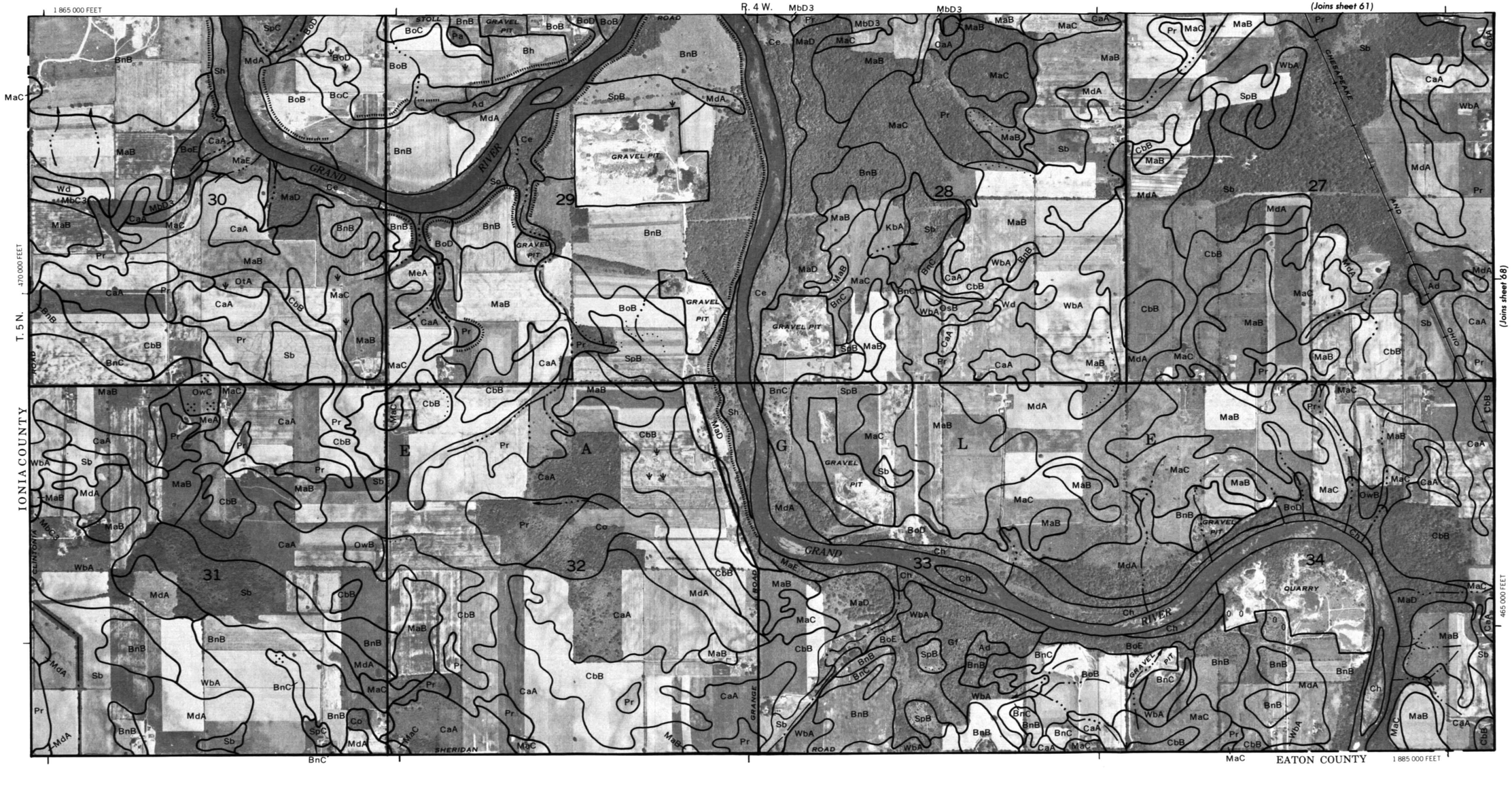
SHIAWASSEE COUNTY

CLINTON COUNTY, MICHIGAN NO. 66

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 67

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



67

N

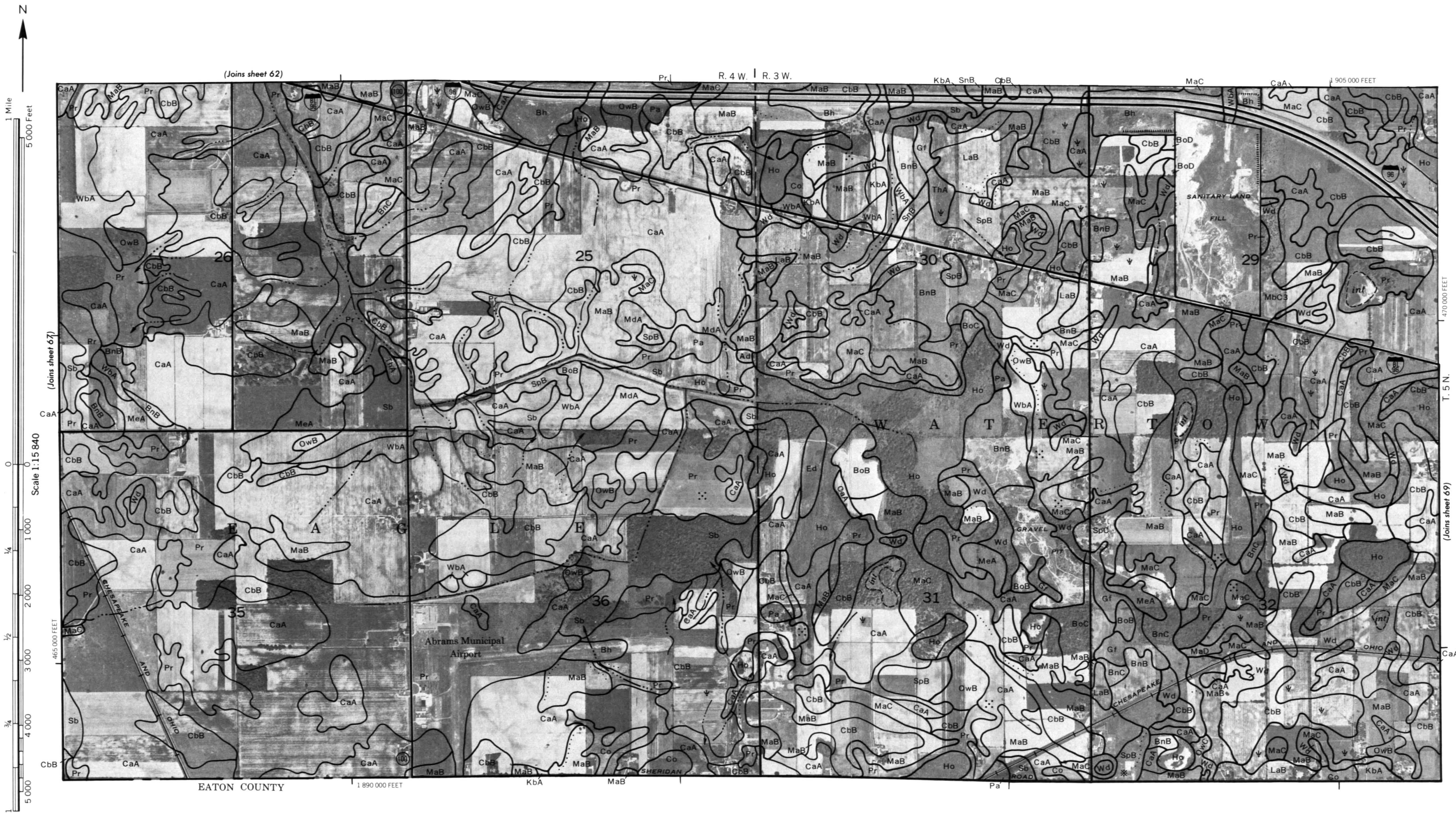
1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 69

This map is compiled on 1972 aerial photographs by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

1 910 000 FEET

470 000 FEET

T. 5 N.

R. 3 W.

(Joins sheet 63)

(Joins sheet 68)

(Joins sheet 70)

465 000 FEET

1 925 000 FEET

EATON COUNTY

MeA

MaD

OwB

MaD

69

N

1 Mile

5 000 Feet

Scale 1:15 840

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

CLINTON COUNTY, MICHIGAN — SHEET NUMBER 70

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 70

CLINTON COUNTY, MICHIGAN NO. 71

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

71

N

R. 2 W. R. 1 W.

1 950 000 FEET

470 000 FEET

T. 5 N.

(Joins sheet 70)

(Joins sheet 65)

(Joins sheet 72)

DEWITT

BATH

CHANDLER

Clinton Village

Park Lake

Davis Airport

CONSOLIDATED

CHANDLER

BEMENT

STOLL ROAD

CORUNNA ROAD

DRAIN

MARSH

GRAVEL PIT

INGHAM COUNTY

1 970 000 FEET

465 000 FEET

1 Mile

5 000 Feet

Scale 1:15 840

72

N

(Joins sheet 66)

R. 1 W.

(Joins sheet 71)

1 990 000 FEET

470 000 FEET

T. 5 N.

465 000 FEET

INGHAM COUNTY

1 975 000 FEET

SHIAWASSEE COUNTY

Scale 1:15 840

1 Mile 5 000 Feet 0 0 ¼ 1 000 ½ 2 000 ¾ 3 000 1 4 000 5 000

Park Lake

Perch Lake

Potter Lake

Mud Lake

Rose Lake

Fox Knoll Lake

Mud Creek

GRAVEL PIT

FILL LAND

SHERIDAN ROAD

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CLINTON COUNTY, MICHIGAN NO. 72